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REPORT NO. 97-03

SINGLE ROUND CONTAINER (LARGE) (SRCXX) PRODUCED BY TELEDYNE BROWN ENGINEERING, S/N EE001TB-EE0042TB, NSN 8140-01-375-7070, CERTIFICATION TESTS

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Chemical Materiel
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The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the Project Manager for Nonstockpile Chemical Materiel (PMNSCM) to conduct First Article Testing (FAT) on the Single Round Container (Large) (SRCXX) chemical overpack container that was manufactured by Teledyne Brown Engineering. These tests were conducted to determine if the SRCXX could meet the test requirements set forth in the DAC Nonstockpile Test Plan for SRCX, SRCXX, MRC-RRS, MRC-7 X 27, MRC-9 X 41, MRC-12 X 56, MRC-21 X 79, and MRC-16.5 X 5.5 dated April 1997. As tested the SRCXX meets and exceeds all test requirements spelled out in the test plan mentioned above.

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SINGLE ROUND CONTAINER (LARGE) (SRCXX) PRODUCED BY TELEDYNE BROWN ENGINEERING, S/N EE001TB-EE0042TB, NSN 8140-01-375-7070, CERTIFICATION TESTS

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by Project Manager for Nonstockpile Chemical Materiel (PMNSCM) to conduct First Article Testing (FAT) on the Single Round Container (Large) (SRCXX) chemical overpack container that was manufactured by Teledyne Brown Engineering. These containers were manufactured under contract DAAA09-95-D-001, with serial numbers EE0001TB to EE0042TB. These tests were conducted to determine if the SRCXX could meet the test requirements set forth in the DAC Nonstockpile Test Plan for SRCX, SRCXX, MRC-RRS, MRC-7 X 27, MRC-9 X 41, MRC-12 X 56, MRC-21 X 79, and MRC-16.5 X 5.5 (dated April 1997).

This test plan was approved by the Chemical Container Approval Authority and was designed to demonstrate the SRCXX meets the performance criteria set forth by the Chemical Container Process Action Team (CCPAT). The SRCXX is intended for transport and storage of chemical munitions in the public domain and is restricted to military air and ground transportation. This container is used to support PMNSCM mission of recovery and containment of chemical warfare materials (CWM).

B. AUTHORITY. These tests were conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE. The objective of these tests is to verify that the SRCXX meets United Nations (UN) Performance Oriented Packaging (POP), Level I; road transportability; high- and low-frequency vibration; drop test and 40-foot drop test requirements for the transport and storage of hazardous chemical agents. These tests are described in the DAC Nonstockpile

MRC Test Plan for SRCX, SRCXX, MRC-RRS, MRC-7 X 27, MRC-9 X 41, MRC-12 X 56, MRC-21 X 79, and MRC-16.5 X 5.5 (dated April 1997).

The objective of these tests is also to provide data to support the Chemical Container Approval of the SRCXX for U.S. Army (USA) use.

D. CONCLUSION. As tested, the SRCXX meets and exceeds all test requirements spelled out in the DAC Nonstockpile MRC Test Plan for SRCX, SRCXX, MRC-RRS, MRC-7 X 27, MRC-9 X 41, MRC-12 X 56, MRC-21 X 79, AND MRC-16.5 X 5.5 (dated April 1997).

PART 2

JANUARY 1998

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PART 3

ITEM TESTED

Item Name	SRCXX
Material	Cold Drawn Steel
Coating	Carc Paint (Green)
Drawing number	15-12-42 to 15-12-48,15-12-511
Manufacturer	Teledyne Brown Engineering
Year of Manufacture	1996
Container Exterior Length	52.25 inches
Container Exterior Diameter	12.0 inches
Container Interior Length	52.25 inches
Container Interior Diameter	11.75 inches
Flange Diameter	15.0 inches
Flange Thickness	1.0 inches
Number of Bolts	10
Bolt Size	0.500 X 20 UNF-2B
Bolt Grade	Grade 8, NSN 5305-01-396-0996
Seal Type	O-Ring
Seal Diameter	12.47 inches +/-.06 inches
Seal Thickness	0.275 inches +/-.06 inches
Seal Material	Butyl Rubber
Container Weight Empty	135 pounds
Container Weight Loaded	340 pounds
Container Shipping Box	3/8-inch Plywood
Container Shipping Box Length (Exterior)	54 inches

Container Shipping Box Width (Exterior)	15-7.8 inches
Container Shipping Box Height (Exterior)	15-7/8 inches
Container Shipping Box Weight	70 pounds
Total Test Weight (Container and Shipping Box)	410 pounds

PART 4

TEST EQUIPMENT

A. Helium Leak Test

1. Manufacturer	Leybold Heraeus
2. Model Number	UL-100
3. Test Method	ASTM E499-73 Title 49 CFR, Section 178.604

B. Compression Test

1. Manufacturer	Ormond Inc.
2. Model Number	TOAFT 266 (50K)
3. Test Method	Title 49 CFR Section 178.606

C. Low Frequency Vibration Test

1. Manufacturer	Gaynes Engineering
2. Model Number	G-6000
3. Test Method	Title 49 CFR, Section 178.608 MIL-STD 810E, Method 514.4
4. Manufacturer	Gaynes Engineering
5. Model Number	G-4000
6. Test Method	Title 49 CFR, Section 178.608 MIL-STD 810E, Method 514.4

D. High Frequency Vibration Test

1. Manufacturer	Ling Engineering
2. Model Number	PP 20/35
3. Test Method	MIL-STD 810E, Method 514.4
4. Tests Conducted By	Datasyst, Delafield, WI

E. Hydrostatic Test

1. Manufacturer	Rice Mfg. Inc.
2. Model Number	H-1500
3. Test Method	Title 49 CFR, Section 178.605

F. Drop Test

1. Manufacturer	Eastern Rotorcraft Corp.
2. Model Number	AWE-49
3. Quick Release Type	Helicopter Cargo Release
4. Test Method	Title 49 CFR, Section 178.603

G. Transportability Test

1. Manufacturer	GMC
2. Type	1.25 ton
3. Nomenclature	CUCV Cargo Truck
4. Test Method	Defense Ammunition Center, TP-94-1

H. Environmental Chamber

1. Manufacturer	Webber Mfg. Inc.
2. Model Number	F125-75 + M5X
3. Controller	Micristar
4. Model Number	828-D00-403-000-120-00

I. Data Recorder

1. Manufacturer	Omnidata
2. Type	Polycorder
3. Model Number	700

J. Pressure Transducer

1. Manufacturer	Omega
2. Model Number	PX236-060GV

PART 5

TEST SEQUENCE

Test Conducted	Test Method
A. Helium-Leak Test	ASTM E-499-73, Method B
B. Road Transportability Tests	DAC TP-94-1
1. Pass 1 over hazard course	DAC TP-94-1, Page 3-2
2. Pass 2 over hazard course	DAC TP-94-1, Page 3-2
3. 30-mile road hazard course	DAC TP-94-1, Page 3-3
4. Pass 3 over hazard course	DAC TP-94-1, Page 3-2
5. Pass 4 over hazard course	DAC TP-94-1, Page 3-2
6. Panic stop at 5 mph	DAC TP-94-1, Page 3-3
7. Panic stop at 10 mph	DAC TP-94-1, Page 3-3
8. Panic stop at 15 mph	DAC TP-94-1, Page 3-3
9. Panic stop at 5 mph in reverse	DAC TP-94-1, Page 3-3
10. Washboard Course	DAC TP-94-1, Page 3-4
C. Helium-Leak Test	ASTM E-499-73, Method B
D. UN POP Stacking Test	Title 49 CFR, Section 178.606
E. Helium-Leak Test	ASTM E-499-73, Method B
F. UN POP Vibration Test	Title 49 CFR, Section 178.608
G. Helium-Leak Test	ASTM E-499-73, Method B
H. UN POP Hydrostatic Test	Title 49 CFR, Section 178.605
I. Helium-Leak Test	ASTM E-499-73, Method B
J. UN POP Longitudinal Drop Test 1	Title 49 CFR, Section 178.603
K. Helium-Leak Test	ASTM E-499-73, Method B
L. UN POP Longitudinal Drop Test 2	Title 49 CFR, Section 178.603
M. Helium-Leak Test	ASTM E-499-73, Method B

Test Conducted	Test Method
N. UN POP Longitudinal Drop Test 3	Title 49 CFR, Section 178.603
O. Helium-Leak Test	ASTM E-499-73, Method B
P. UN POP 45 Degree Drop Test 1	Title 49 CFR, Section 178.603
Q. Helium-Leak Test	ASTM E-499-73, Method B
R. UN POP 45 Degree Drop Test 2	Title 49 CFR, Section 178.603
S. Helium-Leak Test	ASTM E-499-73, Method B
T. UN POP 45 Degree Drop Test 3	Title 49 CFR, Section 178.603
U. Helium-Leak Test	ASTM E-499-73, Method B
V. High-Frequency Vibration Test	MIL-STD 810E, Method 514.4
1. Pre-condition to -35 degrees Fahrenheit	
2. Helicopter Vibration 4 hrs longitudinal	MIL-STD 810E, Method 514.4, Category 6
3. Aircraft vibration 1 hr longitudinal	MIL-STD 810E, Method 514.4, Category 4
4. Precondition to 160 degrees Fahrenheit	
5. Helicopter vibration 4 hrs. Longitudinal	MIL-STD 810E, Method 514.4, Category 4
6. Aircraft vibration 1 hr. Longitudinal	MIL-STD 810E, Method 514.4, Category 6
7. Pre-condition to -35 degrees Fahrenheit	
8. Helicopter vibration 4 hours lateral direction	MIL-STD 810E, Method 514.4, Category 4
9. Aircraft vibration 1 hour lateral direction	MIL-STD810E, Method 514.4, Category 6
10. Pre-condition to 160 degrees Fahrenheit	
11. Helicopter vibration 4 hours lateral direction	MIL-STD 810E, Method 514.4, Category 4
12. Aircraft vibration 1 hour lateral dirction	MIL-STD 810E, Method 514.4, Categroy 6
W. Helium-Leak Test	ASTM E-499-73, Method B
X. Low-Frequency Vibration Test	MIL-STD 810E, Method 514.4
1. Pre-condition to -35 degrees Fahrenheit	
2. 20-minute vibration test vertical direction	MIL-STD 810E, Method 514.4, Category 3
3. Helium-leak test	ASTM E-499-73, Method B

Test Conducted	Test Method
4. Pre-condition to 160 degrees Fahrenheit	
5. 20-minute vibration test vertical direction	MIL-STD 810E, Method 514.4, Category 3
Y. Helium-Leak Test	ASTM E499-73, Method B
Z. Drop Test	
1. Precondition to -35 degrees Fahrenheit	
2. 45 degree drop test	Title 49 CFR, Section 178.603 (Note 1)
3. Helium-leak test	ASTM E499-73, Method B
4. Pre-condition to 160 degrees Fahrenheit	
5. 45 degree drop test	Title 49 CFR, Section 178.603 (Note 1)
AA. Helium-Leak Test	ASTM E499-73, Method B
BB. 40-Foot Drop Test	ARRADOM Drawing Number 883737
CC. Helium Leak Test	ASTM E499-73, Method B

Note 1 Same drop orientation as specified in UN POP requirements, with extreme temperature (-35 degrees Fahrenheit and 160 degrees Fahrenheit) added to verify leak integrity after a drop to the weakest area on the container.

PART 6

TEST PROCEDURES

GENERAL DESCRIPTION AND TEST SEQUENCE

Following is an overview of tests that have been conducted on the SRCXX. The sequence of tests was from the least to the most destructive to minimize the number of test samples required to complete testing. The intent of the overall test program is to simulate all anticipated modes of transportation and temperatures at which these containers are expected to be serviceable during their life cycle. The requirements set forth herein exceed test requirements established in Title 49 CFR for the shipment of hazardous materials. The containers tested were randomly selected from a lot of 60 containers, with serial nos. EE001TB, EE0010TB, and EE0028TB being tested.

CONTAINER TESTING

TRANSPORTABILITY TESTS

TRANSPORTABILITY TESTS.

FAT samples will be subjected to transportability tests in the following sequence: road hazard course, 30-mile road trip, road hazard course, washboard course, and panic stops IAW DAC Test Plan, TP-94-01. These tests will be conducted at ambient temperature with a standard military vehicle(s). Rail impact and shipboard simulation tests will not be conducted on FAT samples, these are not anticipated modes of transportation for these containers.

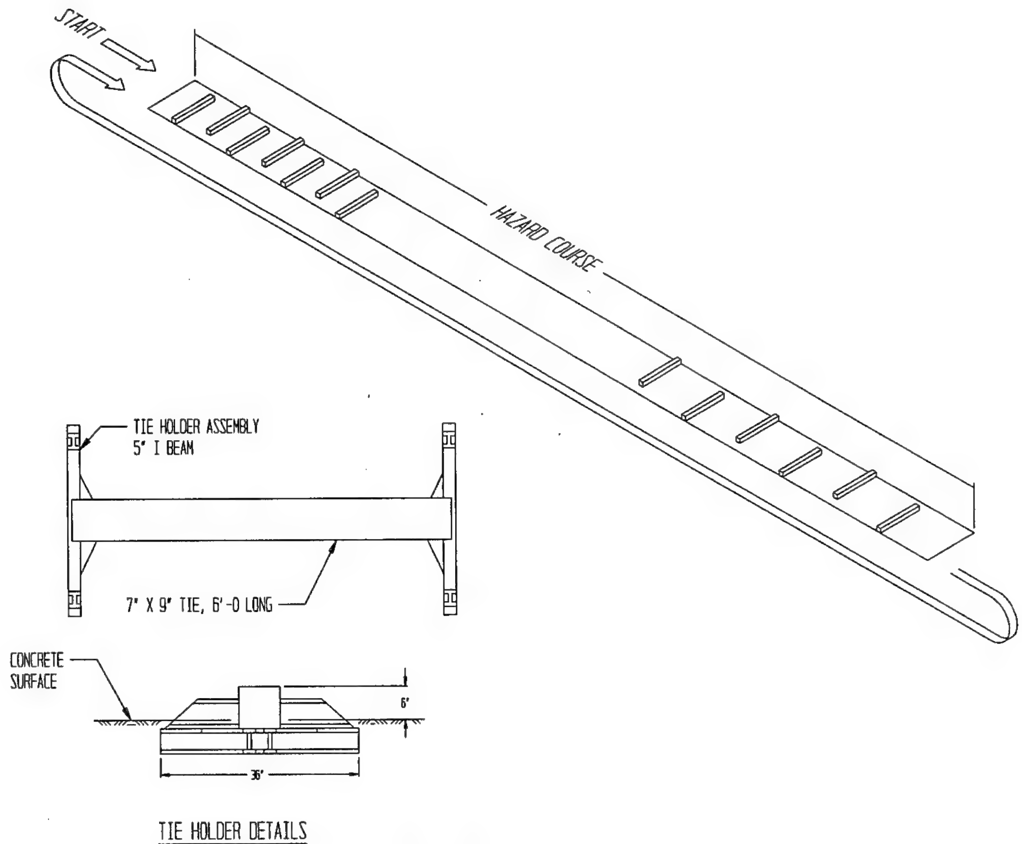
1. Road Hazard Course. This step provides for the specimen load to be driven over a 200-foot-long segment of concrete-paved road which consists of two series of railroad ties projecting 6 inches above the level of the road surface. This hazard course was traversed two times (see Figure 1).

(a) The first series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

(b) Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

(c) The second series of ties is alternately positioned similarly to the first, but spaced on 10-foot centers for a distance of 50 feet.

(d) The test load is driven across the road hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the road hazard course (approximately 5 mph).



FIGUR

2. Road Trip. Using a suitable truck/tractor and trailer, or tactical vehicle, the tactical vehicle/specimen load is driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, or asphalt. Test route included curves, corners, railroad crossings, cattle guards, and stops and starts. The test vehicle travels at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. This step provides for the tactical vehicle/specimen load to be subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 degree grade. The first three stops are at 5, 10, and 15 mph, while the stop in the reverse direction is approximately 5 mph.

3. Road Hazard Course. The first step in the road transportability testing is fully repeated.

4. Washboard Course. Using a suitable truck/tractor, and/or tactical vehicle, the specimen is towed/driven over the washboard course at a speed which produces the most violent response in the particular test load (as indicated by the resonant frequency of the suspension system beneath the load). The washboard course is constructed as shown in Figure 2.

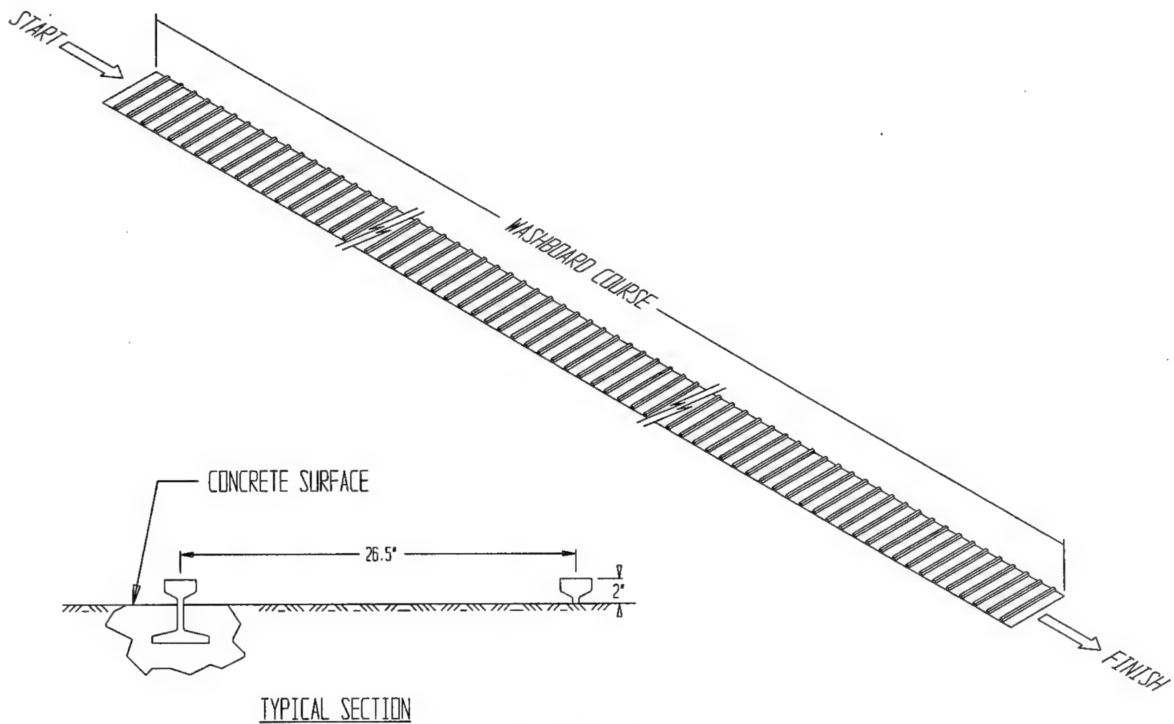


FIGURE 2

UN POP TESTS

UN PERFORMANCE ORIENTED PACKAGING TESTS.

Subpart M

TESTING OF NON-BULK PACKAGINGS AND PACKAGES

Sec. 178.600 Purpose and scope.

This subpart prescribes certain testing requirements for performance-oriented packagings identified in Subpart L of this part.

Sec. 178.601 General requirements.

(a) General. The test procedures prescribed in this subpart are intended to ensure that packages containing hazardous materials can withstand normal conditions of transportation and are considered minimum requirements. Each packaging must be manufactured and assembled so as to be capable of successfully passing the prescribed tests and of conforming to the requirements of § 173.24 of this subchapter at all times while in transportation.

(b) Responsibility. It is the responsibility of the packaging manufacturer and the person who offers a hazardous material for transportation, to the extent that assembly functions including final closure are performed by the latter to assure that each package is capable of passing the prescribed tests.

(c) Definitions. For the purpose of this subpart:

(1) Design qualification testing is the performance of the drop, leakproofness, hydrostatic pressure, stacking, and cooperage tests, as applicable, prescribed in §§ 178.603, 178.604, 178.605, 178.606, or 178.607, respectively, for each new or different packaging, at the start of production of that packaging.

(2) Periodic retesting is the performance of the drop, leakproofness, hydrostatic pressure, and stacking tests, as applicable, prescribed in §§ 178.603, 178.604, 178.605, or 178.606, respectively, at the frequency specified in 178.601(e) of this subpart.

(3) Production testing is the performance of the leakproofness test prescribed in § 178.604 of this subpart on each single or composite packaging intended to contain a liquid.

(4) A different packaging is one that differs (i.e. is not identical) from a previously produced packaging in structural design, size, material of construction, wall thickness or manner of construction but does not include:

(i) A packaging which differs only in surface treatment;

(ii) A combination packaging which differs only in that the outer packaging has been successfully tested with different inner packagings. A variety of such inner packagings may be assembled in this outer packaging without further testing;

(iii) A plastic packaging which differs only with regard to additives which conform to §§ 178.509(b)(4) or (5) of this part;

(iv) A combination packaging with inner packagings conforming to the provisions of paragraph (g) of this section; or

(v) Packagings which differ from the design type only in their lesser design height.

(d) Design qualification testing. The packaging manufacturer shall achieve successful test results for the design qualification testing at the start of production of each new or different packaging.

(e) Periodic retesting. The packaging manufacturer shall achieve successful test results for the periodic retesting at intervals established by the manufacturer of sufficient frequency to ensure that each packaging produced by the manufacturer is capable of passing the design qualification tests. Changes in retest frequency are subject to the approval of the Associate Administrator for Hazardous Materials Safety. For single or composite packagings, the periodic retests must be conducted at least once every 12 months. For combination packagings, the periodic retests must be conducted at least once every 24 months.

(f) Test samples. The manufacturer shall conduct the design qualification and periodic tests prescribed in this subpart using random samples of packagings, in the numbers specified in the appropriate test section. In addition, the leakproofness test, when required, shall be performed on each packaging produced by the manufacturer, and each packaging prior to reuse under § 173.28 of this subchapter, by the reconditioner.

(g) Selective testing. The selective testing of packagings that differ only in minor respects from a tested type is permitted as described in this section. For air transport, packagings must comply with § 173.27(c)(1) and (c)(2) of this subchapter.

(1) Selective testing of combination packagings, Variation 1. Variations are permitted in inner packagings of a tested combination package, without further testing of the package, provided an equivalent level of performance is maintained, as follows:

(i) Inner packagings of equivalent or smaller size may be used provided -

(A) The inner packagings are of similar design to the tested inner packagings (i.e. shape - round, rectangular, etc.);

(B) The material of construction of the inner packagings (glass, plastic, metal, etc.) offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;

(C) The inner packagings have the same or smaller openings and the closure is of similar design (e.g., screw cap, friction lid, etc.);

(D) Sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings;

(E) Inner packagings are oriented with the outer packing in the same manner as in the tested package; and,

(F) The gross mass of the package does not exceed that originally tested.

(ii) A lesser number of the tested inner packagings, or of the alternative types of inner packagings identified in paragraph (g)(1)(i) of this section, may be used provided sufficient cushioning is added to fill void space(s) and to prevent significant movement of the inner packagings.

(2) Selective testing of combination packagings, Variation 2. Inner packagings of any type, for solids or liquids, may be assembled and transported without testing in an outer packaging under the following conditions.

(i) The outer packaging must have been successfully tested in accordance with § 178.603 of this subpart, with fragile (e.g., glass) inner packagings at the Packing Group 1 drop height;

(ii) The total combined gross mass of inner packagings may not exceed one-half the gross mass of inner packagings used for the drop test;

(iii) The thickness of cushioning material between inner packagings and between inner packagings and the outside of the packaging may not be reduced below the corresponding thickness in the originally tested packaging; and when a single inner packaging was used in the original test, the thickness of cushioning between inner packagings may not be less than the thickness of cushioning between the outside of the packaging and the inner packaging in the original test. When either fewer or smaller inner packagings are used (as compared to the inner packagings used in the drop test), sufficient additional cushioning material must be used to take up void spaces.

(iv) The outer packaging must have successfully passed the stacking test set forth in § 178.606 of this subpart when empty, i.e., without either inner packagings or cushioning materials. The total mass of identical packages must be based on the combined mass of inner packagings used for the drop test;

(v) Inner packagings containing liquids must be completely surrounded with a sufficient quantity of absorbent material to absorb the entire liquid contents of the inner packagings;

(vi) When the outer packaging is intended to contain inner packagings for liquids and is not leakproof, or is intended to contain inner packagings for solids and is not sift-proof, a means of containing any liquid or solid contents in the event of leakage must be provided in the form of a leakproof liner, plastic bag, or other equally efficient means of containment; and

(vii) Packagings must be marked in accordance with 178.503 of this part as having been tested to Packing Group 1 performance for combination packagings. The marked maximum gross mass may not exceed the sum of the mass of the outer packaging plus one-half the mass of the filled inner packagings of the tested combination packaging. In addition, the marking required by 178.503(a)(2) of this part must include the letter "V."

(3) Variation 3. Packagings other than combination packagings which are produced with reductions in external dimensions (i.e., length, width or diameter) of up to 25 percent of the dimensions of a tested packaging may be used without further testing provided an equivalent level of performance is maintained. The packagings must, in all other respects (including wall thicknesses), be identical to the tested design-type. The marked gross mass (when required) must be reduced in proportion to the reduction in volume.

(4) Variation 4. Variations are permitted in outer packagings of a tested design-type combination packaging, without further testing, provided an equivalent level of performance is maintained, as follows:

(i) Each external dimension (length, width and height) is less than or equal to the corresponding dimension of the tested design-type;

(ii) The structural design of the tested outer packaging (i.e. methods of construction, materials of construction, strength characteristics of materials of construction, method of closure and material thicknesses) is maintained;

(iii) The inner packagings are identical to the inner packagings used in the tested design type except that their size and mass may be less; and they are oriented within the outer packaging in the same manner as in the tested packaging;

(iv) The same type or design of absorbent materials, cushioning materials and any other components necessary to contain and protect inner packagings, as used in the tested design type, are maintained. The thickness of cushioning material between inner packagings and between inner packagings and the outside of the packaging may not be less than the thickness in the tested design type packaging; and

(v) Sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings. An outer packaging qualifying for use in transport in accordance with all of the above conditions may also be used without testing to transport inner packagings substituted for the originally tested inner packagings in accordance with the conditions set out in Variation 1 in paragraph (g)(1) of this section.

(5) Variation 5. Single packagings (i.e., non-bulk packagings other than combination packaging(s), that differ from a tested design type only to the extent that the closure device or gasketing differs from that used in the originally tested design type, may be used without further testing, provided an equivalent level of performance is maintained, subject to the following conditions (the qualifying tests):

(i) A packaging with the replacement closure devices or gasketing must successfully pass the drop test specified in § 178.602 in the orientation which most severely tests the integrity of the closure or gasket;

(ii) When intended to contain liquids, a packaging with the replacement closure devices or gasketing must successfully pass the leakproofness test specified in § 178.603, the hydrostatic pressure test specified in § 178.605, and the stacking test specified in 178.606. Replacement closures and gasketings qualified under the above test requirements are authorized without additional testing for packagings described in paragraph (g)(3) of this section. Replacement closures and gasketings qualified under the

above test requirements also are authorized without additional testing for different tested design packagings of the same type as the originally tested packaging, provided the original design type tests are more severe or comparable to tests which would otherwise be conducted on the packaging with the replacement closures or gasketings. (For example: The packaging used in the qualifying tests has a lesser packaging wall thickness than the packaging with replacement closure devices or gasketing; the gross mass of the packaging used in the qualifying drop test equals or exceeds the mass for which the packaging with replacement closure devices or gasketing was tested; the packaging used in the qualifying drop test was dropped from the same or greater height than the height from which the packaging with replacement closure devices or gasketing was dropped in design type tests; and the specific gravity of the substance used in the qualifying drop test was the same or greater than the specific gravity of the liquid used in the design type tests of the packaging with replacement closure devices or gasketing.)

(6) The provisions in Variations 1, 2, and 4 in paragraphs (g)(1), (2), and (4) of this section for combination packagings may be applied to packagings containing articles, where the provisions for inner packagings are applied analogously to the articles. In this case, inner packagings need not comply with § 173.27(c)(1) and (c)(2) of this subchapter.

(7) Approval of selective testing. In addition to the provisions of § 178.601(g)(2) of this subpart, the Associate Administrator for Hazardous Materials Safety may approve the selective testing of packagings that differ only in minor respects from a tested type.

(h) Approval of equivalent packagings. A packaging having specifications different from those in §§ 178.505-178.523 of this part, or which is tested using methods or test intervals other than those specified in Subpart M of this Part, may be used if approved by the Associate Administrator for Hazardous Materials Safety. Such packagings must be shown to be equally effective, and testing methods used must be equivalent.

(i) Proof of compliance. Notwithstanding the periodic retest intervals specified in paragraph (e) of this section, the Associate Administrator for Hazardous Materials Safety may at any time require demonstration of compliance by a manufacturer, through testing in accordance with this subpart, that packagings meet the requirements of this subpart. As required by the Associate Administrator for Hazardous Materials Safety, the manufacturer shall either-

(1) Conduct performance tests, or have tests conducted by an independent testing facility, in accordance with this subpart; or

(2) Supply packagings, in quantities sufficient to conduct tests in accordance with this subpart, to the Associate Administrator for Hazardous Materials Safety or a designated representative of the Associate Administrator.

(j) Coatings. If an inner treatment or coating of a packaging is required for safety reasons, the manufacturer shall design the packaging so that the treatment or coating retains its protective properties even after withstanding the tests prescribed by this subpart.

(k) Record retention. The person who certifies the tested design type shall-

(1) Keep records of design qualification tests, including specific types, dates, locations, packaging specifications, test specifics (drop heights, hydrostatic pressures, etc.), results, and test operators' names or name of person responsible for testing, for each packaging at each location where that packaging is manufactured and at each location where design qualification tests are conducted, as long as the packaging is produced and for at least two years thereafter.

(2) Keep records of periodic retests, including specific types, dates, locations, packaging specifications, test specifics (drop heights, hydrostatic pressures, etc.), results, and test operator's names or name of person responsible for testing, at each location where that packaging is

manufactured and at each location where periodic tests are conducted, until such tests are successfully performed again and for at least two years from the date of each test; and

(3) Make all records of design qualification tests and periodic retests available for inspection by a representative of the Department of Transportation upon request.

Sec. 178.602 Preparation of packagings and packages for testing.

(a) Except as otherwise provided in this subchapter, each packaging and package must be closed in preparation for testing and tests must be carried out in the same manner as if prepared for transportation, including inner packagings in the case of combination packagings.

(b) For the drop and stacking test, inner and single-unit receptacles must be filled to not less than 95 percent of maximum capacity (see § 171.8 of this subchapter) in the case of solids and not less than 98 percent maximum capacity in the case of liquids. The material to be transported in the packagings may be replaced by a non-hazardous material, except for chemical compatibility testing or where this would invalidate the results of the tests.

(c) If the material to be transported is replaced for test purposes by non-hazardous material, the material used must be of the same or higher specific gravity as the material to be carried, and its other physical properties (grain, size, viscosity) which might influence the results of the required tests must correspond as closely as possible to those of the hazardous material to be transported. Water may also be used for the liquid drop test under the conditions specified in § 178.603(d)(2) of this subpart. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass, so long as they are placed so that the test results are not affected.

(d) Paper or fiberboard packagings must be conditioned for at least 24 hours immediately prior to testing in an atmosphere maintained-

(1) At 50 percent ± 2 percent relative humidity, and at a temperature of $23^{o}C \pm 2^{o}C$ ($73^{o}F \pm 4^{o}F$). Average values should fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5 percent relative humidity without significant impairment of test reproducibility;

(2) At 65 percent ± 2 percent relative humidity, and at a temperature of $20^{o}C \pm 2^{o}C$ ($68^{o}F \pm 4^{o}F$), or $27^{o}C \pm 2^{o}C$ ($81^{o}F \pm 4^{o}F$). Average values should fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to ± 5 percent relative humidity without significant impairment of test reproducibility; or

(3) For testing at periodic intervals only (i.e., other than initial design qualification testing), at ambient conditions.

(e) Except as otherwise provided, each packaging must be closed in preparation for testing in the same manner as if repaired for actual shipment. All closures must be installed using proper techniques and torques.

(f) Bung-type barrels made of natural wood must be left filled with water for at least 24 hours before the tests.

Sec. 178.603 Drop Test.

(a) General. The drop test must be conducted for the qualification of all packaging design types and performed periodically as specified in § 178.601(e). The number of drops required and the packages' orientations are as follows:

(b) Exceptions. For testing of single or composite packagings constructed of stainless steel, nickel, or monel at periodic intervals only (i.e., other than design qualification testing), the drop test may be conducted with two samples, one sample each for the two drop orientations. These samples may have been previously used for the hydrostatic pressure or stacking test. Exceptions for the number of steel and aluminum packaging samples used for conducting the drop test are subject to the approval of the Associate Administrator for Hazardous Materials Safety.

(c) Special preparation of test samples for the drop test. Testing of plastic drums, jerricans, and boxes, composite packagings with inner plastic receptacles, and of combination packagings with inner plastic receptacles, other than expanded plastic boxes and bags, must be carried out when the temperature of the test sample and its contents has been reduced to -18°C(0°F) or lower. Test liquids shall be kept in the liquid state if necessary, by the addition of anti-freeze. Test samples prepared in this way are not required to be conditioned in accordance with § 178.602(d).

Packaging	No. of tests	Drop orientation of samples
Steel drums, Aluminum drums, Metal drums (other than steel or aluminum), Steel jerricans, Plywood drums, Wooden barrels, Fiber drums, Plastic drums and jerricans, Composite packagings which are in the shape of a drum.	Six — (three for each drop)	First drop (using three samples): The package must strike the target diagonally on the chime or, if the packaging has no chime, on the circumferential seam or an edge. Second drop (using the other three samples): The package must strike the target on the weakest part not tested by the first drop, for example a closure or, for some cylindrical drums, the welded longitudinal seam of the drum body.
Boxes of natural wood, Plywood boxes, Reconstituted wood boxes, Fiberboard boxes, Plastic boxes, Steel or aluminum boxes, Composite packagings which are in the shape of a box.	Five — (one for each drop)	First drop: Flat on the bottom (using the first sample). Second drop: Flat on the top (using the second sample). Third drop: Flat on the long side (using the third sample). Fourth drop: Flat on the short side (using the fourth sample). Fifth drop: On a corner (using the fifth sample).
Bags — single-ply with a side seam.	Three — (three drops per bag) .	First drop: Flat on a wide face (using all three samples). Second drop: Flat on a narrow face (using all three samples). Third drop: On an end of the bag (using all three samples).
Bags — single-ply without a side seam, or multi-ply	Three — (three drops per bag) .	First drop: Flat on a wide face (using all three samples). Second drop: On an end of the bag (using all three samples).

(d) Target. The target must be a rigid, non-resilient, flat and horizontal surface.

(e) Drop height. Drop heights, measured as the vertical distance from the target to the lowest point on the package, must be determined as follows:

(1) For solids and liquids, if the test is performed with the solid or liquid to be transported or with a non-hazardous material having essentially the same physical characteristic, the drop height must be determined according to packing group, as follows:

(i) Packing Group I: 1.8 m (5.9 feet).

(ii) Packing Group II: 1.2 m (3.9 feet).

(iii) Packing Group III: 0.8 m (2.6 feet).

(2) For liquids, if the test is performed with water-

(i) Where the materials to be carried have a specific gravity not exceeding 1.2, drop height must be determined according to packing group, as follows:

(A) Packing Group I: 1.8 m (5.9 feet).

(B) Packing Group II: 1.2 m (3.9 feet).

(C) Packing Group III: 0.8 m (2.6 feet).

(ii) Where the materials to be transported have a specific gravity exceeding 1.2, the drop height must be calculated on the basis of the specific gravity (SG) of the material to be carried, rounded up to the first decimal, as follows:

(A) Packing Group I: SG x 1.5 m (4.9 feet).

(B) Packing Group II: SG x 1.0 m (3.3 feet).

(C) Packing Group III: SG x 0.67 m (2.2 feet).

(f) Criteria for passing the test. A package is considered to successfully pass the drop tests for each sample tested if-

(1) For receptacles containing liquid, each receptacle does not leak when equilibrium has been reached between the internal and external pressures;

(2) For removable head drums for solids, the entire contents are retained by an inner packaging (e.g., a plastic bag) even if the closure on the top head of the drum is no longer sift-proof;

(3) For a bag, neither the outermost ply nor an outer packaging exhibits any damage likely to adversely affect safety during transport;

(4) For a composite or combination packaging, there is no damage to the outer packaging likely to adversely affect safety during transport, and there is no leakage of the filling substance from the inner packaging;

(5) For a drum, jerrican or bag, any discharge from a closure is slight and ceases immediately after impact with no further leakage; and

(6) No rupture is permitted in packagings for materials in Class 1 which would permit spillage of loose explosive substances or articles from the outer packaging.

Sec. 178.604 Leakproofness test.

(a) General. The leakproofness test must be performed with compressed air or other suitable gases on all packagings intended to contain liquids, except that:

(1) The inner receptacle of a composite packaging may be tested without the outer packaging provided the test results are not affected; and

(2) This test is not required for inner packagings of combination packagings.

(b) Number of packagings to be tested-

(1) Production testing. All packagings subject to the provisions of this section must be tested and must pass the leakproofness test;

(i) Before they are first used in transportation; and

(ii) Prior to reuse, when authorized for reuse by § 173.28 of this subchapter.

(2) Design qualification and periodic testing. Three samples of each different packaging must be tested and must pass the leakproofness test. Exceptions for the number of samples used in conducting the leakproofness tests are subject to the approval of the Associate Administrator for Hazardous Materials Safety.

(c) Special preparation-

(1) For design qualification and periodic testing, packagings must be tested with closures in place. For production testing, packagings need not have their closures in place. Removable heads need not be installed during production testing.

(2) For testing with closures in place, vented closures must either be replaced by similar non-vented closures or the vent must be sealed.

(d) Test method. The packaging must be restrained under water while an internal air pressure is applied; the method of restraint must not affect the results of the test. The test must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. Other methods, at least equally effective, may be used in accordance with Appendix B of this part.

(e) Pressure applied. An internal air pressure (gauge) must be applied to the packaging as indicated for the following packaging groups;

(1) Packing Group I: Not less than 30 kPa (4 psi).

(2) Packing Group II: Not less than 20 kPa (3 psi).

(3) Packing Group III: Not less than 20 kPa (3 psi).

(f) Criteria for passing the test. A packaging passes the test if there is no leakage of air from the packaging.

Sec. 178.605 Hydrostatic pressure test.

(a) General. The hydrostatic pressure test must be conducted for the qualification of all metal, plastic, and composite packaging design types intended to contain liquids and be performed periodically as specified in § 178.601(e). This test is not required for inner packagings of combination packagings. For internal pressure requirements for inner packagings of combination packings intended for transportation by aircraft, see § 173.27(c) of this subchapter.

(b) Number of test samples. Three test samples are required for each different packaging. For packagings constructed of stainless steel, monel, or nickel, only one sample is required for periodic retesting of packagings. Exceptions for the number of aluminum and steel sample packagings used in conducting the hydrostatic pressure test are subject to the approval of the Associate Administrator of Hazardous Materials Safety.

(c) Special preparation of receptacles for testings. Vented closures must either be replaced by similar non-vented closures or the vent must be sealed.

(d) Test method and pressure to be applied. Metal packagings and composite packagings other than plastic (e.g., glass, porcelain or stoneware), including their closures, must be subjected to the test pressure for 5 minutes. Plastic packagings and composite packagings (plastic material), including their closures, must be subjected to the test pressure for 30 minutes. This pressure is the one to be marked as required in § 178.503(a)(5) of this part. The receptacles must be supported in a manner that does not invalidate the test. Then test pressure must be applied continuously and evenly, and it must be kept constant throughout the test period. The hydraulic pressure (gauge) applied, taken at the top of the receptacle, and determined by any one of the following methods must be:

(1) Not less than the total gauge pressure measured in the packaging (i.e., the vapor pressure of the filling material and the partial pressure of the air or other inert gas minus 100 kPa (15 psi) at 55°C (131°F) and multiplied by a safety factor of 1.5. This total gauge pressure must be determined on the basis of a maximum degree of filling in accordance with § 173.24a(b)(3) of this subchapter and a filling temperature of 15°C (59°F);

(2) Not less than 1.75 times the vapor pressure at 50°C (122°F) of the material to be transported minus 100 kPa (15 psi) but with a minimum test pressure of 100 kPa (15 psi); or

(3) Not less than 1.5 times the vapor pressure at 55°C (131°F) of the material to be transported minus 100 kPa (15 psi), but with a minimum test pressure of 100 kPa (15 psi).

Packagings intended to contain hazardous materials of Packing Group I must be tested to a minimum test pressure of 250 kPa (36 psi).

(e) Criteria for passing the test. A package passes the hydrostatic test if, for each test sample, there is no leakage of liquid from the package.

Sec. 178.606 Stacking test.

(a) General. All packaging design types other than bags must be subjected to a stacking test.

(b) Number of test samples. Three test samples are required for each different packaging. For periodic retesting of packagings constructed of stainless steel, monel, or nickel, only one test sample is required. Exceptions for the number of aluminum and steel sample packagings used in conducting the stacking test are subject to the approval of the Associate Administrator of Hazardous Materials Safety. Notwithstanding the provisions of § 178.602(a) of this subpart, combination packagings maybe subjected to the stacking test without their inner packagings, except where this would invalidate the results of the test.

(c) Test method-

(1) Design qualification testing. The test sample must be subjected to a force applied to the top surface of the test sample equivalent to the total weight of identical packages which might be stacked on it during transport. The minimum height of the stack, including the test sample, must be 3.0 m (10 feet). The duration of the test must be 24 hours, except that plastic drums, jerricans, and composite packaging 6HH, intended for liquids, shall be subjected to the stacking test for a

period of 28 days at a temperature of not less than 40°C (104°F). Alternative test methods which yield equivalent results may be used if approved by the Associate Administrator for Hazardous Materials Safety.

(2) Periodic retesting. The test sample must be tested in accordance with:

(i) Section 178.606(c)(1) of this subpart; or

(ii) The packaging may be tested using a dynamic compression testing machine. The test must be conducted at room temperature on an empty, unsealed packaging. The test sample must be centered on the bottom platen of the testing machine. The top platen must be lowered until it comes in contact with the test sample. Compression must be applied end to end. The speed of the compression tester must be one-half inch plus or minus one-fourth inch per minute. An initial preload of 50 pounds must be applied to ensure a definite contact between the test sample and the platens. The distance between the platens at this time must be recorded as zero deformation. For "A" to be applied, "A" must be calculated using the following formula:

Liquids: $A = (n-1)\,[w + (s \times v \times 8.3 \times .98)] \times 1.5$;

Solids: $A = (n-1)\,[w + (s \times v \times 8.3 \times .95)] \times 1.5$;

Where:

A = applied load in pounds

n = minimum number of containers that, when stacked, read a height of 3 m

s = specific gravity of lading

w = maximum weight of one empty container in pounds

v = actual capacity of container (rated capacity + outage) in gallons

And:

8.3 corresponds to the weight in pounds of 1.0 gallon of water.

1.5 is a compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing.

(d) Criteria for passing the test. No test sample may leak. In composite packagings or combination packagings, there must be no leakage of the filling substance from the inner receptacle, or inner packaging. No test sample may show any deterioration which could adversely affect transportation safety or any distortion likely to reduce its strength, cause instability in stacks of packages, or cause damage to inner packagings likely to reduce safety in transportation. Stacking stability is considered sufficient when, after the stacking test, and, in the case of plastic packagings after cooling to ambient temperature, two packagings of the same type filled with water placed on each test sample maintain their positions for one hour. For the dynamic compression test, a container passes the test if, after application of the required load, there is no buckling of the sidewalls sufficient to cause damage to its expected contents; in no case may the maximum deflection exceed one inch.

Sec. 178.607 Cooperage test for bung-type wooden barrels.

(a) Number of samples. One barrel is required for each different packaging.

(b) Method of testing. Remove all hoops above the bilge of an empty barrel at least two days old.

(c) Criteria for passing the test. A packaging passes the cooperage test only if the diameter of the cross-section of the upper part of the barrel does not increase by more than 10 percent.

Sec. 178.608 Vibration standard.

(a) Each packaging must be capable of withstanding, without rupture or leakage, the vibration test procedure outlined in this section.

(b) Test method.

(1) Three sample packagings, selected at random, must be filled and closed as for shipment.

(2) The three samples must be placed on a vibrating platform that has a vertical or rotary double-amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform, but must be left free to move vertically, bounce and rotate.

(3) The test must be performed for one hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material approximately 1.6 mm (0.063 inch) thickness (such as steel strapping or paperboard) can be passed between the bottom of any package and the platform.

(4) Immediately following the period of vibration, each package must be removed from the platform, turned on its side and observed for any evidence of leakage.

(5) Other methods, at least equally effective, may be used. If approved by the Associate Administrator for Hazardous Materials Safety.

(c) Criteria for passing the test. A packaging passes the vibration test if there is no rupture or leakage from any of the packages. No test sample should show any deformation which could adversely affect transportation safety or any distortion liable to reduce packaging strength.

(1) Helium test. The packaging must be filled with at least 1 L inert helium gas, air tight closed, and placed in a testing chamber. The testing chamber must be evacuated down to a pressure of 5 kPa which equals an over-pressure inside the packaging of 95 kPa. The air in the testing chamber must be analyzed for traces of helium gas by means of a mass spectrograph. The test must be conducted for a period of time sufficient to evacuate the chamber and to determine if there is leakage into or out of the packaging. If helium gas is detected, the leaking packaging must be automatically separated from non-leaking packagings and the leaking area determined according to the method prescribed in 178.604(d) of the subchapter. A packaging passes the test if there is no leakage of helium.

(2) Pressure differential test. The packaging shall be restrained while either pressure or a vacuum is applied internally. The packaging must be pressurized to the pressure required by 178.604(e) of this subchapter for the appropriate packing group. The method of restraint must not affect the results of the test. The test must be conducted for a period of time sufficient to appropriately pressurize or evacuate the interior of the packaging and to determine if there is leakage into or out of the packaging. A packaging passes the pressure differential test if there is no change in measured internal pressure.

(3) Solution over seams. The packaging must be restrained while an internal air pressure is applied; the method of restraint may not affect the results of the test. The exterior surface of all seams and welds must be coated with a solution of soap suds or a water and oil mixture. The test

must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging.

(4) Solution over partial seams test. For drums, the following test may be used: The packaging must be restrained while an internal air pressure of 48 kPa (7.0 psig) is applied; the method of restraint may not affect the results of the test. The packaging must be coated with a soap solution over the entire side seam and a distance of not less than eight inches on each side of the side seam along the chime seam(s). The test must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging. Chime cuts must be made on the initial drum at the beginning of each production run and on the initial drum after any adjustment to the chime seamer. Chime cuts must be maintained on file in date order for not less than six months and be made available to a representative of the Department of Transportation on request.

HELIUM-LEAK TESTING

Designation: E 499 – 73 (Reapproved 1980)

Standard Methods of Testing for

LEAKS USING THE MASS SPECTROMETER LEAK DETECTOR IN THE DETECTOR PROBE MODE[1,2]

This Standard is issued under the fixed designation E 499; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 These methods cover procedures for testing and locating the sources of gas leaking at the rate of 1×10^{-8} standard cubic centimetres per second (standard cm^3/s) or greater. The test may be conducted on any device or component across which a pressure differential of helium or other suitable tracer gas may be created, and on which the effluent side of the leak to be tested is accessible for probing with the mass spectrometer sampling probe.

1.2 Two methods are described:

1.2.1 *Method A*—Direct probing, and

1.2.2 *Method B*—Accumulation.

2. Summary of Methods

2.1 Section 1.8 of Ref (1)[3] will be of value to some users in determining which leak test method to use.

2.2 These methods require a leak detector with a full-scale readout of at least 1×10^{-7} standard cm^3/s on the most sensitive range, a maximum 1-min drift of zero and sensitivity of ± 5 % of full scale on this range, and ± 2 % or less on others (see 4.1). The above sensitivities are those obtained by probing an actual standard leak in atmosphere with the detector, or sampling, probe, and *not* the sensitivity of the detector to a standard leak attached directly to the vacuum system.

2.3 *Method A, Direct Probing* (see Fig. 1), is the simplest test, and may be used in parts of any size, requiring only that a tracer gas pressure be created across the area to be tested, and the searching of the atmospheric side of the area be with the detector probe. This method detects leakage and its source or sources. Experience has shown that leak testing down to 1×10^{-7} standard cm^3/s in factory environments will usually be satisfactory if reasonable precautions against releasing gas like the tracer gas in the test area are observed, and the effects of other interferences (Section 3) are considered.

2.4 *Method B, Accumulation Testing* (see Fig. 2), provides for the testing of parts up to several cubic metres in volume as in Fig. 2a or in portions of larger devices as in Fig. 2b. This is accomplished by allowing the leakage to accumulate in the chamber for a fixed period, while keeping it well mixed with a fan, and then testing the internal atmosphere for an increase in tracer gas content with the detector probe. The practical sensitivity attainable with this method depends primarily on two things: first, on the volume between the chamber and the object; and second, on the amount of outgassing of tracer gas produced by the object. Thus, a part having considerable exposed rubber, plastic, blind cavities or threads cannot be tested with the sensitivity of a smooth metallic part. The time in which a leak can be detected is directly proportional to the leak rate and inversely proportional to the volume between the chamber and the part. In theory, extremely small leaks can be detected by this

[1] These methods are under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing.

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[2] (Atmospheric pressure external, pressure above atmospheric internal). This document covers the Detector Probe Mode described in Recommended Guide E 432, for the Selection of a Leak Testing Method, which appears in the *Annual Book of ASTM Standards*, Part 11.

[3] The boldface numbers in parentheses refer to the list of references appended to these methods.

method; however, the time required and the effects of other interferences limit the practical sensitivity of this method to about 1×10^{-4} standard cm^3/s for small parts.

3. Interferences

3.1 *Atmospheric Helium*—The atmosphere contains about five parts per million (ppm) of helium, which is being continuously drawn in by the detector probe. This background must be "zeroed out" before leak testing using helium can proceed. Successful leak testing is contingent on the ability of the detector to discriminate between normal atmospheric helium, which is very constant, and an increase in helium due to a leak. If the normally stable atmospheric helium level is increased by release of helium in the test area, the reference level becomes unstable, and leak testing more difficult.

3.2 *Helium Outgassed from Absorbent Materials*—Helium absorbed in various nonmetallic materials (such as rubber or plastics) may be released during the test. If the rate and magnitude of the amount released approaches the amount released from the leak, the reliability of the test is decreased. The amount of such materials or their exposure to helium must then be reduced to obtain a meaningful test.

3.3 *Pressurizing with Test Gas*—In order to evaluate leakage accurately, the test gas in all parts of the device must contain substantially the same amount of tracer gas. When the device contains air prior to the introduction of test gas, or when an inert gas and a tracer gas are added separately, this may not be true. Devices in which the effective diameter and length are not greatly different (such as tanks) may be tested satisfactorily by simply adding tracer gas. However, when long or restricted systems are to be tested, more uniform tracer distribution will be obtained by first evacuating to a few torr, and then filling with the test gas. The latter must be premixed if not 100 % tracer.

3.4 *Dirt and Liquids*—As the orifice in the detector probe is very small, the parts being tested should be clean and dry to avoid plugging. Reference should be frequently made to a standard leak to ascertain that this has not happened.

4. Apparatus

4.1 *Helium Leak Detector* equipped with atmospheric detector probe. To perform tests as specified in this standard, the detector should be adjusted for testing with helium and should meet the following minimum requirements:

4.1.1 *Sensor Mass Analyzer.*

4.1.2 *Readout*—Panel instrument or digital readout.

4.1.3 *Range (Linear)*—Sensitivity of most sensitive range 1×10^{-4} standard cm^3/s full scale (see Section 6).

4.1.4 *Response Time*—3 s or less.

4.1.5 *Stability of Zero and Sensitivity*—A maximum variation of ±5 % of full scale on most sensitive range while probe is active; a maximum variation of ± 2 % of full scale on other ranges, for a period of 1 min.

4.1.6 *Controls:*

4.1.6.1 *Range*, preferably in steps of about 3×.

4.1.6.2 *Zero*, having sufficient range to null out atmospheric helium.

4.2 *Helium Leak Standard*—To perform leak tests as specified in this standard, the leak standard should meet the following minimum requirements:

4.2.1 *Ranges*—10×10^{-3} to 10×10^{-4} standard cm^3/s full scale, calibrated for discharge to atmosphere.

4.2.2 *Adjustability*—Adjustable leak standards are a convenience, but are not mandatory.

4.2.3 *Accuracy*—±25 % of full-scale value or better.

4.2.4 *Temperature Coefficient* shall be stated by manufacturer.

4.3 *Helium Leak Standard as in 4.2*, but with ranges from 10×10^{-4} to 10×10^{-7} standard cm^3/s calibrated for discharge to vacuum.

4.4 *Other Apparatus*—Fixtures or other equipment specific to one test method are listed under that method.

5. Material

5.1 *Test Gas Requirements:*

5.1.1 To be satisfactory, the test gas shall be nontoxic, nonflammable, not detrimental to common materials, and inexpensive. Helium, or helium mixed with air, nitrogen, or some

other suitable inert gas meets the requirements. If the test specification allows leakage of 1×10^{-4} standard cm³/s or more, or if large vessels are to be tested, consideration should be given to diluting the tracer gas with another gas such as dry air or nitrogen. This will avoid excessive helium input to the sensor and in the case of large vessels, save tracer gas expense (Note 1).

5.1.2 *Producing Premixed Test Gas*—If the volume of the device or the quantity to be tested is small, premixed gases can be conveniently obtained in cylinders. The user can also mix gases by batch in the same way. Continuous mixing using calibrated orifices is another simple and convenient method when the test pressure does not exceed 50 % of the tracer gas pressure available.

NOTE 1—When a vessel is not evacuated prior to adding test gas, the latter is automatically diluted by one atmosphere of air.

5.2 *Liquid Nitrogen*, or other means of cold trap refrigeration as specified by the maker of the leak detector.

6. Calibration

6.1 The leak detectors used in making leak tests by these methods are not calibrated in the sense that they are taken to the standards laboratory, calibrated, and then returned to the job. Rather, the leak detector is used as a comparator between a leak standard (4.2) (set to the specified leak size) which is part of the instrumentation, and the unknown leak. However, the sensitivity of the leak detector is checked and adjusted on the job so that a leak of specified size will give a readily observable, but not off-scale reading. More specific details are given in Section 7 under the test method being used. To verify sensitivity, reference to the leak standard should be made before and after a prolonged test. When rapid repetitive testing of many items is required, refer to the leak standard often enough to assure that desired test sensitivity is maintained.

7. Procedure

7.1 *General Considerations:*

7.1.1 *Test Specifications*—A testing specification shall be in hand. This shall include:

7.1.1.1 The gas pressure on the high side of the device to be tested; also on the low side if it need differ from atmospheric pressure.

7.1.1.2 The test gas composition, if there is need to specify it.

7.1.1.3 The maximum allowable leak rate in standard cubic centimetres per second.

7.1.1.4 Whether the leak rate is for each leak or for total leakage of the device.

7.1.1.5 If an "each leak" specification, whether or not other than seams, joints, and fittings needs to be tested.

7.1.2 *Safety Factor*—Where feasible, it should be ascertained that a reasonable safety factor has been allowed between the actual operational requirements of the device and the maximum specified for testing. Experience indicates that a factor of at least 10 should be used when possible. For example, if a maximum total leak rate for satisfactory operation of a device is 5×10^{-6} standard cm³/s, the test requirement should be 5×10^{-7} standard cm³/s or less.

7.1.3 *Test Pressure*—The device should be tested at or above its operating pressure and with the pressure drop in the normal direction, where practical. Precautions should be taken so that the device will not fail during pressurization, or that the operator is protected from the consequences of a failure.

7.1.4 *Disposition or Recovery of Test Gas*—Test gas should never be dumped into the test area if further testing is planned. It should be vented outdoors or recovered for reuse if the volume to be used makes this worthwhile.

7.1.5 *Detrimental Effects of Helium Tracer Gas*—This gas is quite inert, and seldom causes any problems with most materials, particularly when used in gaseous form for leak testing and then removed. When there is a question as to the compatibility of the tracer with a particular material, an authority on the latter should be consulted. This is particularly true when helium is sealed in contact with glass or other barriers that it may permeate.

7.1.6 *Correlation of Test Gas Leakage with Other Gases or Liquids at Different Operating Pressures:*

7.1.6.1 Given the normal variation in leak geometry, accurate correlation is an impossibility. However, if a safety factor of ten or more is allowed, in accordance with 7.1.2, adequate correlation for gas leakage within these limits can usually be obtained by assuming viscous

flow and using the relation:

$$Q_2 = (Q_1 N_1/N_2)[(P_2^2 - P_1^2)/(P_4^2 - P_3^2)]$$

where:

Q_2 = test leakage, standard cm³/s,

Q_1 = operational leakage, standard cm³/s,

N_2 = viscosity of test gas (Note 2),

N_1 = viscosity of operational gas (Note 2),

P_2, P_1 = absolute pressures on high and low sides at test, and

P_4, P_3 = absolute pressures on high and low sides in operation (Note 3).

7.1.6.2 Experience has shown that, at the same pressures, gas leaks smaller than 1×10^{-5} standard cm³/s will not show visible leakage of a liquid, such as water, which evaporates fairly rapidly. For slowly evaporating liquids such as lubricating oil, the gas leakage should be another order of magnitude smaller, 1×10^{-6} standard cm³/s. See Ref (2) for further discussion of this topic.

NOTE 2—Viscosity differences between gases are a relatively minor effect and can be ignored if desired.

NOTE 3—It will be observed from this formula that the leakage increases at a rate considerably greater than that of the pressure increase. For this reason it is often desirable to increase the sensitivity of the test by testing at the maximum safe pressure for the part. Increased sensitivity may even be obtained with the same amount of helium by increasing the pressure with another less expensive gas, such as air.

7.2 *Method A* (refer to 2.3 and Fig. 1):

7.2.1 *Apparatus:*

7.2.1.1 *Test Specification.*

7.2.1.2 *Helium Leak Detector*, with atmospheric detector, sampling probe.

7.2.1.3 *Helium Leak Standard*, discharge to atmosphere. Size equal to helium content of maximum leak rate per specification.

7.2.1.4 *Helium Leak Standard*, discharge to vacuum. Size: anywhere between 1×10^{-6} and 1×10^{-8} standard cm³/s, unless otherwise specified by maker of leak detector.

7.2.1.5 *Test Gas*, at or above specification pressure.

7.2.1.6 *Pressure Gages, Valves, and Piping* for introducing test gas, and if required, vacuum pump for evacuating device.

7.2.1.7 *Liquid Nitrogen*, if required.

7.2.2 *Procedure:*

7.2.2.1 Set helium leak standard at maximum helium content of specification leakage.

Example:

Max leak rate: 1×10^{-4} standard cm³/s
Test gas: 1 % helium in air. Set standard at $1 \times 10^{-4} \times 0.01 = 1 \times 10^{-6}$ standard cm³/s

7.2.2.2 Start detector, warm up, fill trap with liquid nitrogen if required, and adjust in accordance with manufacturer's instructions, using leak standard 7.2.1.4 attached to vacuum system.

7.2.2.3 Attach atmospheric detector probe to detector sample port in place of leak standard and open valve of detector probe, if adjustable type is being used, to maximum leak rate under which detector will operate properly.

7.2.2.4 Rezero detector to compensate for atmospheric helium.

7.2.2.5 With orifice of leak standard (7.2.1.3) in a horizontal position, hold the tip of the detector probe directly in line with and 0.06 ± 0.02 in. (1.5 ± 0.5 mm) away from the end of the orifice, and observe reading (Note 4).

7.2.2.6 Remove probe from standard leak and note minimum and maximum readings due to atmospheric helium variations or other instabilities.

7.2.2.7 If 7.2.2.6 is larger than 30 % of 7.2.2.5, take steps to reduce the helium added to the atmosphere, or to eliminate other causes of instability. If this cannot be done, testing at this level of sensitivity may not be practical.

7.2.2.8 Evacuate (if required) and apply test gas to device at specified pressure.

7.2.2.9 *Probe Areas Suspected of Leaking*—Probe shall be held on or not more than 0.04 in. (1 mm) from the surface of the device, and moved not faster than 0.8 in./s (20 mm/s). If leaks are located which cause a "reject" indication when the probe is held not over 0.04 in. (1 mm) from the apparent leak source, repair all such leaks before making final acceptance test.

7.2.2.10 Maintain an orderly procedure in probing the required areas, preferably identifying them as tested, and plainly indicating points of leakage.

7.2.2.11 At completion of the test evacuate or purge test gas from the device, if required.

7.2.2.12 Write a test report or otherwise indicate test results as required.

NOTE 4—If necessary to obtain a reasonable instrument deflection, adjust range, rezero if necessary, and reapply sampling probe to leak standard.

7.3 *Method B* (refer to 2.4 and Fig. 2):

7.3.1 *Apparatus*—Same as for Method A, except that equipment for enclosing all or part of the item to be tested is required as shown in Fig. 2.

7.3.2 *Procedure:*

7.3.2.1 *Set-up*—Same as 7.2.2.1 through 7.2.2.7, Method A, except that somewhat larger variations in atmospheric helium can be tolerated due to the isolation of the part during test.

7.3.2.2 *Sensitivity Setting*—In general, it will be advantageous to use the maximum stable sensitivity setting on the leak detector, in order to reduce the accumulation time to a minimum.

7.3.2.3 Insert the part to be tested (unpressurized), the leak standard (7.2.1.3), and the detector probe in the Fig. 2 enclosure.

7.3.2.4 Note the rate of increase of detector indication.

7.3.2.5 Remove the leak standard, pressurize the part with test gas, and again note rate of rise, if any. If 7.3.2.5 exceeds 7.3.2.4, reject part.

7.3.2.6 Remove the part from the enclosure and purge out any accumulated helium.

7.3.2.7 Evacuate or purge test gas from the part, if required.

7.3.2.8 Write a test report or otherwise indicate test results as required.

REFERENCES

(1) Marr, J. William, "Leakage Testing Handbook," prepared for Liquid Propulsion Section, Jet Propulsion Laboratory, National Aeronautics and Space Administration, Pasadena, Calif., Contract NAS 7-396, June 1967.

(2) Santeler, D. J., and Moller, T. W., "Fluid Flow Conversion in Leaks and Capillaries," *Vacuum Symposium Transactions*, Pergamon Press, London, 1956, p 29. Also General Electric Company Report R56GL261.

(3) Howl, D. A., and Mann, C. A., "The Back-Pressurizing Technique of Leak Testing," *Vacuum*, Vol 15, No. 7, 1965, pp 347–352.

(4) Olson, R. E., "Safety Hazards of High Pressure Leak Checks," paper presented at 56th Air Force/Industry Conference on Missile Leaks and Spills, February 24–26, 1965, Los Angeles, Calif.

(5) Roberts, J. A., "Precision Leaks for Standardizing Leak Detection Equipment," *Vacuum Symposium Transactions*, 1965, p 124.

(6) Bialous, A. J., *Characteristics and Sources of Commercially Available Leak Detectors*, General Electric Company, Report S-67-1013, April 1967.

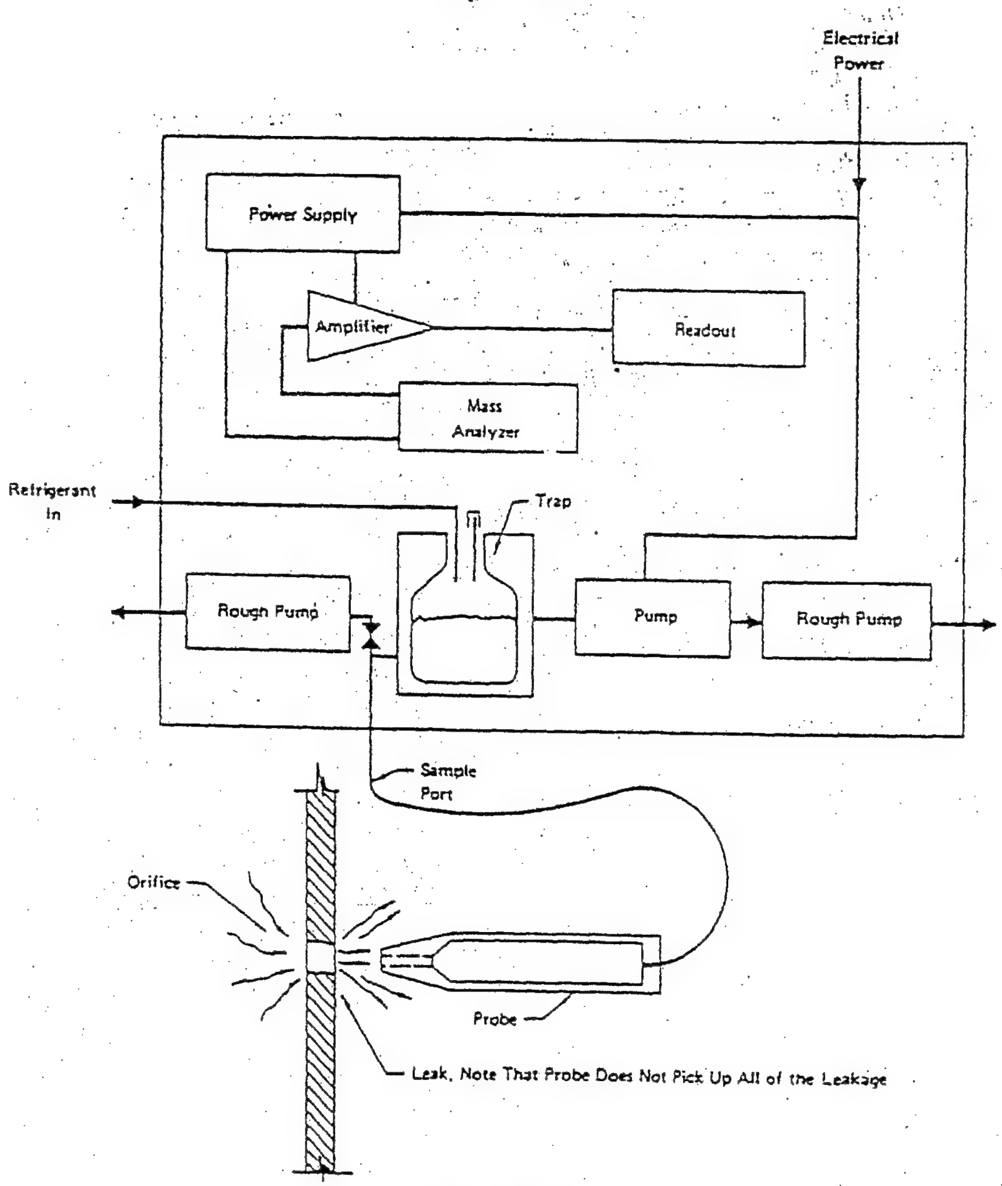
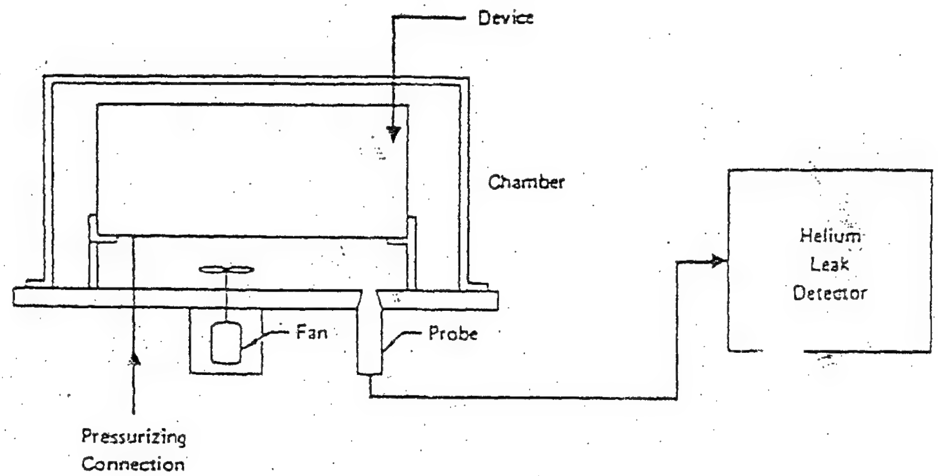
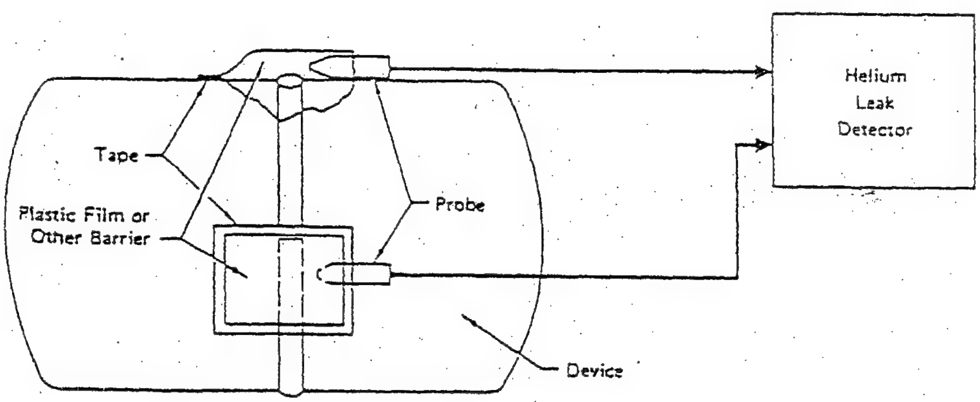


FIG 1 Method A.



a) Accumulation Leak Test, Complete Device in Chamber



b) Accumulation Leak Test, Flexible Shroud over a Small Portion of Device

FIG 2 Method B.

VIBRATION TESTING

I-3.3.2.2 Test level. The vibration levels and intensities received by the test item during this test are based upon the course profile and vehicle speeds as specified in procedure II. Various road surfaces are to be used, each traversed at speeds which will produce the desired vibration intensity. Transport vehicle speeds are limited either by the vehicle's safe operating speed over a specific course profile or by the speed limit set for the specific course.

I-3.3.2.3 Test duration. The test duration shall be as specified in procedure II or until the test item has received the exposure representative of the anticipated deployment scenarios, whichever is longer.

I-3.3.3 Category 3 - Loose cargo transport.

I-3.3.3.1 Application. This test is intended to simulate the unrestrained collision of the test item with the bed and sides of the transport vehicle as well as with other cargo. The loose cargo environment includes conditions experienced by packaged and unpackaged items transported as unsecured cargo on a vehicle traversing irregular surfaces. The cargo has the freedom to bounce, scuff, or collide with other items of cargo or with the sides of the vehicle. This environment is simulated in the laboratory by imparting motion to the test item and allowing it to collide with restraints established within the test setup. The test conditions for this environment are established, to a large extent, by the equipment used to impart the motion, and the arrangement of the restraints as described in procedure III. This test has few tailoring options and the selection of the test equipment must be based upon the desired end result.

I-3.3.3.2 Test levels. The basic movement of the bed of the test equipment where the test item is placed is a 2.54-cm diameter orbital path at 5 Hz, such as can be obtained on a standard package tester operating in the synchronous mode. (In this mode any point on the bed of the package tester will move in a circular path in a vertical plane perpendicular to the axes of the shafts.)

I-3.3.3.3 Test conditions. The test conditions for this procedure are based on the results of two methodology studies (References 56 and 57). The former study determined that testing of packaged items on a package tester in a circular synchronous mode with a plywood-covered bed at 300 rpm provides a reasonable simulation of the loose cargo transportation environment. A test duration of 20 minutes represents a scenario of 240 km (all three axes simultaneously) of truck transportation (which encompasses the severity and duration of the two-wheeled trailer and tracked vehicle environments), over the various road profiles found in the transport scenario from the Corps storage area to a using unit (see figure 514.4-6). The latter study determined that testing of circular cross-section items and unpackaged equipment on a package tester with a steel-covered bed and in the same mode and speed as for packaged items, provides a reasonable simulation of the loose cargo transportation environment for those items. The test duration of 20 minutes again represents 240km as for the packaged items.

I-3.4 Operational environments

I-3.4.1 Category 4 - Propeller aircraft and turbine engines.

I-3.4.1.1 Background information. Service vibration frequency spectra for equipment installed in propeller aircraft consist of a broadband background with superimposed narrow band spikes. The background spectrum results from various random sources (see I-3.4.2) with many periodic (not pure sinusoidal) components due to the rotating elements (engines, gearboxes, shafts, etc.) associated with turboprops. The spikes are produced by the passage of pressure fields rotating with the propeller blades. These occur in relatively narrow bands centered on the propeller passage frequency (number of blades multiplied by the propeller rpm) and harmonics.

The spectrum for equipment mounted directly on turbine engines is similar to the propeller aircraft spectrum except the primary spike frequency is the rotational speed of the rotor(s).

Most current propeller aircraft and many turbine engines are constant-speed machines. This means that rpm is held constant and power changes are made through fuel flow changes and variable-pitch blades, vanes, and propellers. These machines produce the fixed frequency spikes of figure 514.4-7. These spikes have an associated bandwidth because there is minor rpm drift and because the vibration is not pure sinusoidal (I- 4.5).

There are indications that future turboprop or propfan engines will not be constant- speed machines. All reciprocating engines and many turbine engines are not constant- speed. Also modern turbofan engines usually have two and sometimes three mechanically independent rotors operating at different speeds. The spectra of figure 514.4-7 must be modified if used for these.

These vibration environments can be approximated in the laboratory by the source dwell test described in I-4.2.2. Many vibration problems in this type of environment are associated with the coincidence of equipment vibration modes and the excitation spikes. The notches between spikes are used in intelligent design as safe regions for critical vibration modes. Thus source dwell tests minimize the likelihood that equipment will be overstressed at non-representative conditions and that reasonable design provisions will not be subverted.

I-3.4.1.2 Test level. Whenever possible, flight vibration measurements should be used to develop vibration criteria for laboratory tests. In the absence of flight measurements, the test levels of table 514.4-II can be used with the spectra of figure 514.4-7. The turboprop levels are based on data from various C-130 and P-3 aircraft measurements and are fairly representative of the environments of those aircraft. The decline of spike acceleration spectral density with frequency is based on relatively recent data analyzed in a spectral density format. Engine levels are based on data measured on several current Air Force aircraft engines.

All equipment items protected from vibration by isolators should also pass the minimum integrity test requirements of I-3.4.9 with the test item hard-mounted to the fixture.

I-3.4.1.3 Test duration. Test durations should be developed from flight measurements or field data. If field data are not available for development of the test durations, tests should be conducted for one hour per axis at the test levels listed in table 514.4-II, modified according to the guidance in I-4.3, I-4.6 and I-4.7. These levels represent maximum actual operating conditions and are functional test levels.

I-3.4.2 Category 5 - Jet aircraft

I-3.4.2.1 Background information. The vibration environment for equipment installed in jet aircraft (except engine-mounted) stems from four principal mechanisms. These vibrations are random and, except where the elastic response of primary aircraft structure is the source, broadband. These sources are as follows:

a. Engine noise impinging on aircraft structures.

b. Turbulent aerodynamic flow along external aircraft structures.

c. Pressure pulse impingement due to repetitive firing of guns.

d. Airframe structural motions due to maneuvers, aerodynamic buffet, landing, taxi, etc.

The guidance provided in this section considers sources (a) and (b) above. Method 519 covers source (c). General airframe motions (d) cannot be adequately covered by general criteria. They are the result of responses of flexible structures to various transient events. Two examples of such responses are the rebound of wings and pylons when heavy stores are ejected, and the separated flow or shed vortex excitation of flight surfaces during sustained maneuvers. The vibration spectra are characteristic of the particular airframe involved and must be evaluated through measured data. Airframe structural motions are usually important for the outer regions of flexible structures (i.e. outer 1/2 of wings, empennage, pylons, etc). They are usually not important for fuselage-mounted equipment.

Jet-noise-induced vibration is usually dominant in vehicles which operate at lower dynamic pressures, i.e., limited to subsonic speeds at lower altitudes and

transonic speeds at high altitudes. Aerodynamically induced vibration usually predominates in vehicles which operate at transonic speeds at lower altitudes or supersonic speeds at any altitude.

When equipment is used in more than one application, the vibration criteria should be enveloped and test criteria based on a worst-case composite. Only functional tests are performed for tactical missiles.

TABLE 514.4-II. Suggested functional test conditions for propeller aircraft and turbine engine equipment (see figure 514.4-7).

Equipment Location 2/, 3/	Vibration Level of L_1, at F_1, (g^2/Hz) 4/5/
In fuselage or wing forward of propeller	0.1
In fuselage or wing aft of propeller	0.3
In engine compartment or pylons	0.6
Equipment mounted directly on aircraft engines	1.0

1/ F_1 = fundamental excitation frequency; F_i = source frequency (i = 1-4). $F_2 = 2F_1$, $F_3 = 3F_1$, $F_4 = 4F_1$

2/ When panels and racks are not available for equipment installed on vibration isolated panels or racks, or when the equipment is tested with isolators removed, use "fuselage or wing forward of propeller" category with levels reduced 4 dB.

3/ Increase test levels 6 dB for equipment mounted on fuselage or wing skin within one propeller blade radius of the plane of the propeller disc. For all other skin mounted equipment, increase levels by 3 dB.

4/ Bandwidth of vibration around each F_i will equal ±5% F_i for constant-speed excitation. When excitation is not constant-speed, bandwidth will encompass operating speeds for cruise and high power operation.

5/ F_1 = 68 Hz for most C-130 aircraft.

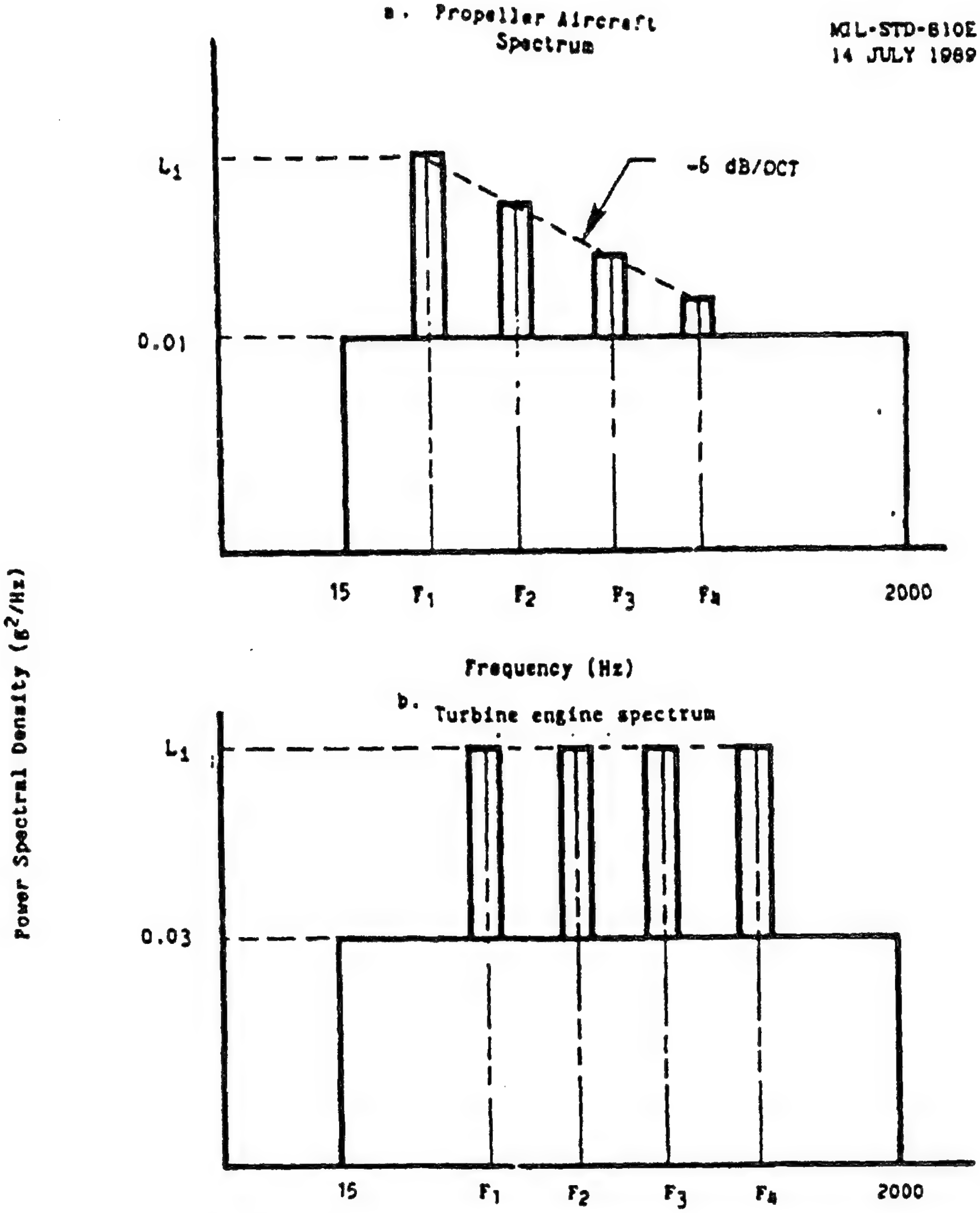


FIGURE 514.4-7. Suggested vibration spectra for propeller aircraft and equipment on turbine engines.

I-3.4.2.2 Test levels. In the absence of satisfactory measurements of field environments, functional test levels approximating jet-noise-induced and flow-induced vibration may be derived from table 514.4-III and figure 514.4-8. Use the envelope of the worst case aerodynamic and worst case jet noise induced vibrations.

I-3.4.2.3 Test duration. Test durations should be developed from field data and/or intended usage. The guidance of I-3.4.9, I-4.3, I-4.6, and I-4.7 applies.

I-3.4.3 Category 6 - Helicopter installed.

I-3.4.3.1 Background information. Helicopter vibration is characterized by dominant sinusoids superimposed on a broadband random background as depicted in figure 514.4-9. These sinusoids are generated by the rotating components of the helicopter, primarily the main rotor, but which also include the tail rotor, engine(s), drive shafts and gear meshing. The normal operating speeds of these components are generally constant, varying less than five percent. However, recent designs have taken advantage of variable rotor speed control which generates a pseudo steady state rotor speed at values between 95% to 110% of the nominal 100% rotor speed, thus complicating the component design and test process as all steady state rotor speeds, pseudo or otherwise, must be accounted for. The broadband random background is attributed to fuselage aerodynamics.

The relative amplitudes of the sinusoids differ throughout the helicopter structure. The vibration environment at the location of the test item is dependent on its proximity to the vibration excitation source, as well as on the structure and geometry of the helicopter. Thus, the need for measured data is especially acute. A clear requirement for helicopter component design is the avoidance of coincidence of the installed components' resonant frequencies with the helicopter excitation frequencies at the installed component aircraft location. It is important to note that, in general, helicopter excitation frequencies and amplitudes are different for each helicopter type. A typical laboratory vibration will include four (4) sinusoids superimposed on a broadband random background. For fuselage-mounted components, refer to I-3.4.3.2 through I-3.4.3.4. For components mounted on engines, refer to I-3.4.1. For components exposed to gunfire vibration, the requirements of Method 519 shall be additionally imposed.

TABLE 514.4-III. Broadband Vibration test values for jet aircraft equipment.

Criteria

Aerodynamically induced vibration (figure 514.4-8) 1/

Functional test level 3/

$$W_o = K(q)^2$$

Jet engine noise induced vibration (figure 514.4-8) 1/

Functional test level 2/, 3/, 4/, 5, 6/

$$W_o = (0.48\ (\cos^2\theta)/R)[D_c\ (V_c/A)^3 + D_f(V_f/A)^3]$$

K	=	1.18×10^{-11} for cockpit panel equipment and equipment attached to structure in compartments adjacent to external surfaces that are smooth, free from discontinuities. ($K = 2.7 \times 10^{-8}$ if q is in lb/ft^2)
K	=	6.11×10^{-11} for equipment attached to structure in compartments adjacent to or immediately aft of external surfaces having discontinuities (cavities, chines, blade antennas, speed brakes, etc.) and equipment in wings, pylons, stabilizers, and fuselage aft of trailing edge wing root. ($K = 14 \times 10^{-8}$ if q is in lb/ft^2)
q	=	57.46 kN/m^2 (1200 lb/ft^2) or maximum aircraft q, whichever is less.
D_c	=	engine core exhaust diameter, meters (feet). (For engines without fans, use maximum exhaust diameter).
D_f	=	engine fan exhaust diameter, meters (feet).
R	=	minimum distance between center of engine aft exhaust plane and the center of gravity of installed equipment, meters (feet).
V_c	=	engine core exhaust velocity, meters per sec (feet per sec). (For engines without fans, use maximum exhaust velocity without afterburner).
V_f	=	engine fan exhaust velocity, meters per second (feet per sec).
θ	=	angle between R line and engine exhaust axis, aft-vectored, degrees.
A	=	1850 if engine exhaust velocities are in feet/sec.
A	=	564 if engine velocities are in meters/sec.

TABLE 514.4-III. Broadband Vibration test values for jet aircraft equipment. Continued

NOTES

1/ Worst case aerodynamic and jet engine induced vibration should be identified and enveloped.

2/ If the aircraft has more than one engine, W_o shall be the sum of the individually computed values for each engine.

3/ To account for the effect of equipment inertia on vibration levels, W_o may be multiplied by a mass loading factor, M, based on equipment weight in kilograms (pounds). This does not apply to equipment which is on isolators.

$$M_f = 10^{(0.6 - Kg/60)};$$

$$M_f = 10^{(0.6 - 0.0075\ lb)}$$

Values of M_f are restricted to the range 0.25 to 1.0.

4/ For $70° < \theta \leq 180°$, use $\theta = 70°$ to compute W_o.

5/ For engines with afterburner, use W_o, which is four times larger than W_o computes using maximum V_c and V_f without afterburner.

6/ For instrument panel equipment, reduce the 0.04 G^2/Hz value of figure 514.4-8 by 3 dB and reduce the calculated value W_o by 6 dB for functional testing. Endurance is 0.04 g^2/Hz.

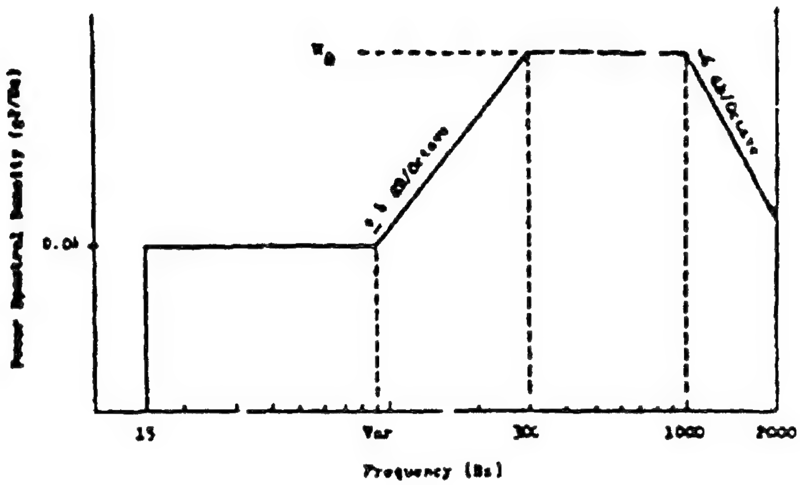


Figure 514.4-8. <u>Vibration test spectrum for jet aircraft.</u>

EQUIPMENT LOCATION	W_o	W_1	F_t
General	.001	.01	500
Instrument Panel	.001	.01	500
External Stores	.002	.02	500
On/Near Drive Train Elements	.002	.02	2000

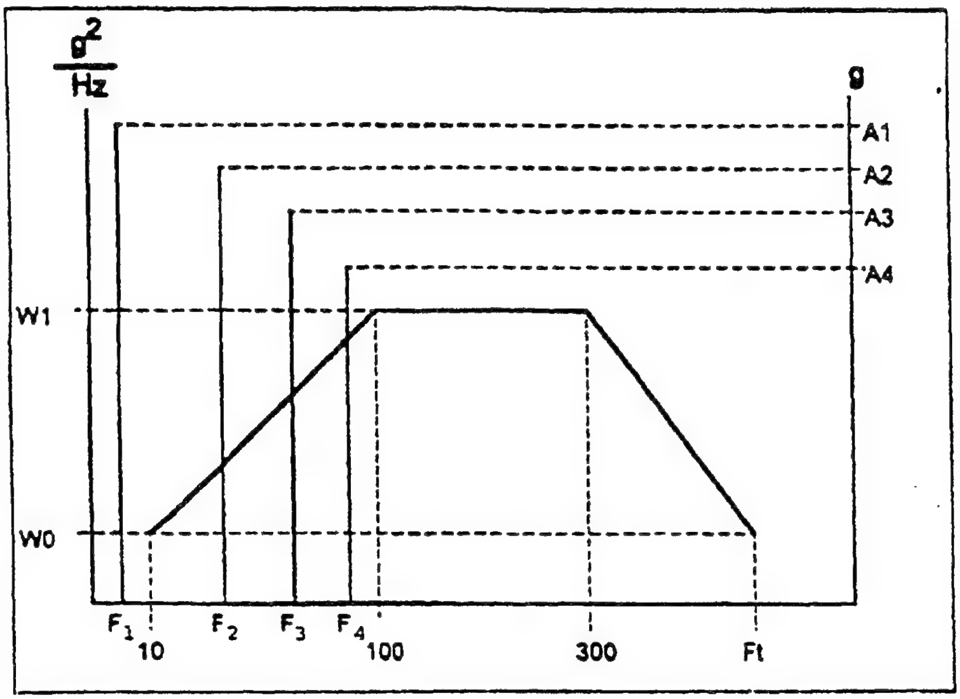


Figure 514.4-9. Vibration spectrum for equipment mounted on helicopters.

I-3.4.3.2 Test frequencies. For laboratory test purposes, the aircraft can be divided into three zones as depicted in Figure 514.4-10. For components located in the vertical projection of the main rotor, the laboratory test frequencies are the fundamental rotational frequency of the main rotor (1P), and the harmonics of 1P multiplied by the number of blades in the main rotor system (n). For components located in the horizontal projection of the tail rotor, the laboratory test frequencies are the fundamental rotational frequency of the tail rotor (1T), and the harmonics of 1T multiplied by the number of blades in the tail rotor system (m). Thus, laboratory test frequencies (labeled F_1, F_2, F_3 and F_4) for a component located in the vertical projection of the main rotor are determined as:

$$F_1 = 1P$$
$$F_2 = nP$$
$$F_3 = 2nP$$
$$F_4 = 3nP$$

A similar calculation is made for components located in the horizontal projection of the tail rotor. The fundamental main and tail rotor frequencies and the number of rotor blades are defined for various helicopter types in Table 514.4-V. All equipment located on or in close proximity to the drive train such as gear boxes and drive shafts should use the source frequencies of that drive train component (i.e., gear mesh frequencies, shaft rotational speeds, etc.). These drive train source frequencies are also aircraft-specific.

I-3.4.3.3 Test amplitudes. The test amplitudes are labeled A_1, A_2, A_3 and A_4 and are associated with excitation frequencies F_1, F_2, F_3 and F_4. Whenever possible, the test amplitudes for equipment installed on helicopters should be derived from aircraft measured values at the component installation location. These measured amplitudes are then amplified to derive a component test duration equivalent to the life of the component. The time-scaling is delineated in I-3.4.3.4. However, when measured data are not available, the frequency-dependent amplitudes can be determined from Figures 514.4-9 and 514.4-10, and from Tables 514.4-IV and 514.4-V. These default amplitudes are an attempt at enveloping potential worst-case environments; they do not represent environments under which vibration sensitive equipment should be expected to perform. However, the components are expected to survive and function to specification at the completion of the test. Consequently, performance vibration amplitudes should be tailored to particular applications.

I-3.4.3.4 Test duration. Utilizing the default test amplitudes delineated in I-3.4.3.3, the test duration shall be four (4) hours of excitation for each of three (3) mutually perpendicular axes for a total test time of twelve (12) hours per component. If a test amplitude other than the default amplitude is used, the test

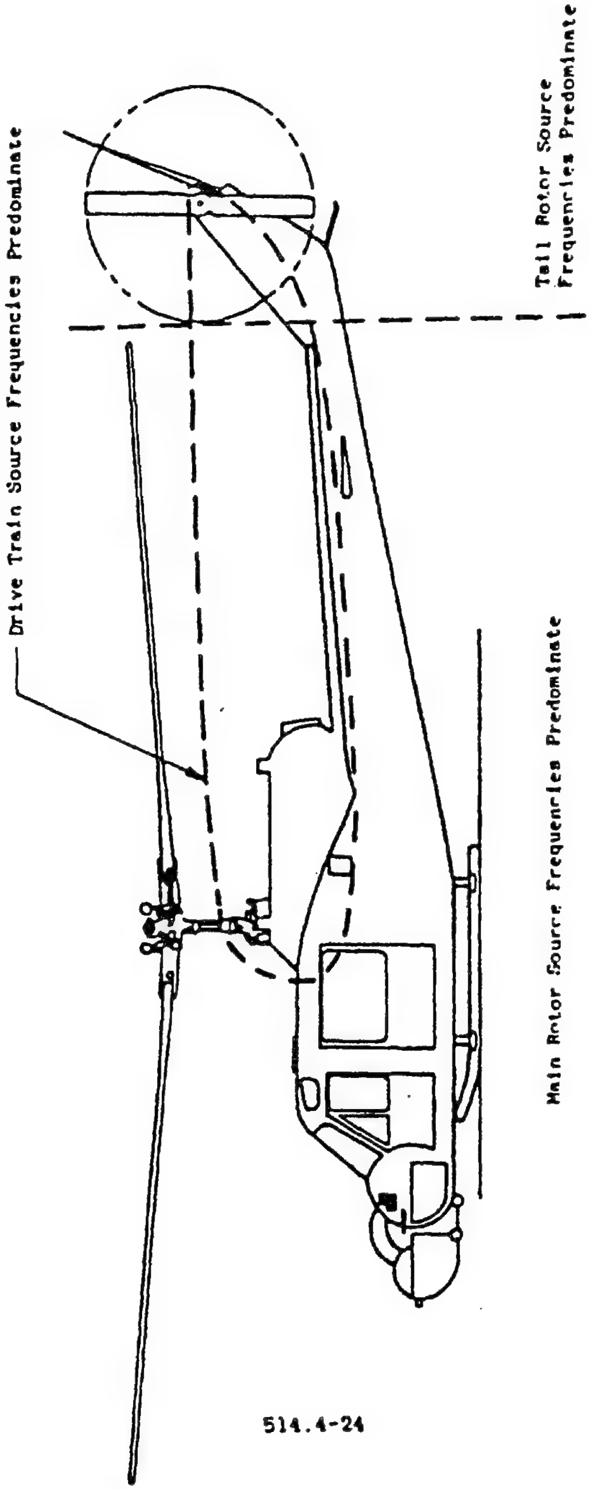


FIGURE 514.4-10 Zones for rotary wing aircraft.

duration shall be scaled as follows:

$$t_f = 4.0 \left(\frac{A_T}{A_D}\right)^{-6}$$

where t_f = actual test time per axis
A_D = default test amplitude
A_T = actual test amplitude

The longest resultant t_f determined from the various combinations of the frequency-dependent A_T/A_D ratios shall be utilized.

TABLE 514.4-IV. Default test peak amplitudes for equipment on helicopters.

Equipment Location	Source Frequency (F_x) Range (Hz)	Peak Amplitude (A_x) at F_x (g's)
General (1)	3-10 10-25 25-40 40-50 50-500	$0.7/(10.7-F_x)$ $0.1 * F_x$ 2.5 $6.5-0.1 * F_x$ 1.5
Instrument Panel (1)	3-10 10-25 25-40 40-50 50-500	$0.7/(10.7-F_x)$ $0.07 * F_x$ 1.75 $4.55-0.07 * F_x$ 1.05
External Stores (1)	3-10 10-25 25-40 40-50 50-500	$0.7/(10.7-F_x)$ $0.15 * F_x$ 3.75 $9.75-0.15 * F_x$ 2.25
On/Near Drive Systems' Elements (2)	5-50 50-2000	$0.1 * F_x$ $5.0 + 0.01 * F_x$

NOTES:
(1) F_x = Excitation frequency, x = 1, 2, 3 or 4
F_1 = Fundamental excitation frequency (Rotor rotational speed)
F_2 = nF_1 or mF_1 (Blade passage frequency)
F_3 = $2nF_1$ or $2mF_1$ (Blade passage frequency)
F_4 = $3nF_1$ or $3mF_1$ (Blade passage frequency)
where n (or m) = number of main (or tail) rotor blades (Table 514.4-V)

Upon determining values of F_1, through F_4 (Figure 514.4-9), select the appropriate excitation frequency range for each to determine the peak amplitudes.

(2) F_1, F_2, F_3, F_4 must be determined from drive train areas for the particular helicopter. NOTE (1) is then applicable.

I-3.4.4 Category 7A - Assembled external stores, jet aircraft. Assembled jet aircraft stores will encounter three distinct vibration environments: captive flight, buffet maneuver, and free flight.

I-3.4.4.1 Captive flight. Extensive measurement programs have shown that the vibration experienced by an externally carried store on a jet aircraft arises from three distinct sources:

a. Aerodynamic boundary layer turbulence.

b. Buffet maneuvers.

c. Aircraft-induced vibration.

In general, store vibration is primarily caused by broadband aerodynamic boundary layer turbulence and is relatively independent of the carrying aircraft and mounting location on the aircraft. Instead, vibratory excitation is mostly influenced by store shape, mounting configuration and dynamic pressure. This source of vibration is distributed along the entire surface of the store and is difficult to simulate by point input of vibration, such as from a vibration shaker, unless the store is relatively stiff. Therefore, an acoustic test (Method 515) is recommended for this environment.

TABLE 514.4-V. Fundamental source frequencies (F_1).

HELICOPTER	MAIN ROTOR 1P (Hz)	TAIL ROTOR 1T (Hz)	n (Blades)	m (Blades)
AH-1	5.4	27.7	2	2
AH-6J	7.8	47.5	5	2
AH-64	4.8	23.4	4	4
CH-47D	3.75	1/	3	
MH-6H	7.8	47.5	5	2
OH-6A	8.1	51.8	4	2
OH-58A/C	5.9	43.8	2	2
OH-58D	6.6	39.7	4	2
UH-1	5.4	27.7	2	2
UH-60	4.3	19.8	4	4

1/ The CH-47D has two (2) main rotors and no tail rotor.

II-1.2.1.2 Category 4 - Propeller Aircraft The test item shall be installed in a vibration fixture which simulates the actual application configuration. To the extent practical, the vibration test setup should incorporate actual mounting and installation provisions from the carrying aircraft. Fixture designs which utilize the maximum amount of platform structure possible will allow the best item to respond to the laboratory excitation in a manner more closely duplicating its response in the actual field environment.

II-1.2.1.3 Category 5 - Jet aircraft. (See II-1.2.1.2)

II-1.2.1.4 Category 6 - Helicopter. The test item shall be attached to the vibration exciter by means of a fixture capable of transmitting the vibration conditions specified. The fixture shall be designed by utilizing actual racks, panels or platform structures of the helicopter to minimize the introduction of unrepresentative response within the test item.

II-1.2.1.5 Category 7A - Assembled external stores, jet aircraft.

II-1.2.1.5.1 Fixtures. Suspend the store from a structural support by means of its normal mounting lugs, hooks and sway braces simulating the operational mounting configuration. Include launcher or mounting rails where applicable. Rigid body store suspension modes shall be between 5 and 20 Hz except that the highest rigid body mode shall be no higher than one half the lowest test frequency. In some instances in the past stores have been hard mounted to large shakers. This has proven to be inadequate and should not be attempted.

Vibration shall be transmitted to the store by means of a rod or other suitable mounting devices running from vibration shakers to the surface of the store. The tie points on the store surface shall be relatively hard and structurally supported by the store internal structure or supported by an external fixture (usually a ring around the local store diameter) attached to the store. Separate driving points will be required to drive the verical and lateral axes. Separate driving points at each end in each axis are also recommended although aligning a single driving point in each axis with the store aerodynamic center has also been successful.

II-1.2.1.5.2 Accelerometers. Accelerometers to monitor the vibratory response of the store should be mounted on two relatively hard points or rings within the store, one in the nose section and one in the aft section. For stores such as bombs with nonintegral tail cones, the aft-section mounting point should be in the aftmost section of the main body of the store. At each mounting point or ring, two accelerometers should be mounted--one in the vertical and one in the lateral plan. (Longitudinal direction is along the axis of the store; the vertical direction is defined as perpendicular to the longitudinal axis and contained in a plane passing through the mounting lugs).

II-1.2.1.6 Category 7B - Equipment installed in externally carried stores. (See II.1.2.1.2)

II-1.2.1.7 Category 7C - Assembled external stores, helicopters. Testing shall be accomplished in three mutually perpendicular axes with the mounting lugs in the up position. The test item should be attached to the fixture by its normal mounting means (e.g., suspension lugs for the 2.75 inch FFAR launcher). The vibration fixture shall utilize, if feasible, actual aircraft components for accomplishing this test attachment.

II-1.2.1.8 Category 8 - Ground mobile. The test item shall be attached to the vibration generator directly or with a fixture, and securely held by its normal means of attachment. The fixture shall incorporate actual service structures as much as possible to minimize unrealistic response characteristics during test exposure. Any connection to the test item, such as cables, pipes, wires, and the like, shall be arranged so that it imposes restraints and mass similar to those present when the equipment is installed in the operational configuration.. Excitation shall be applied through the three orthogonal axes of the test item.

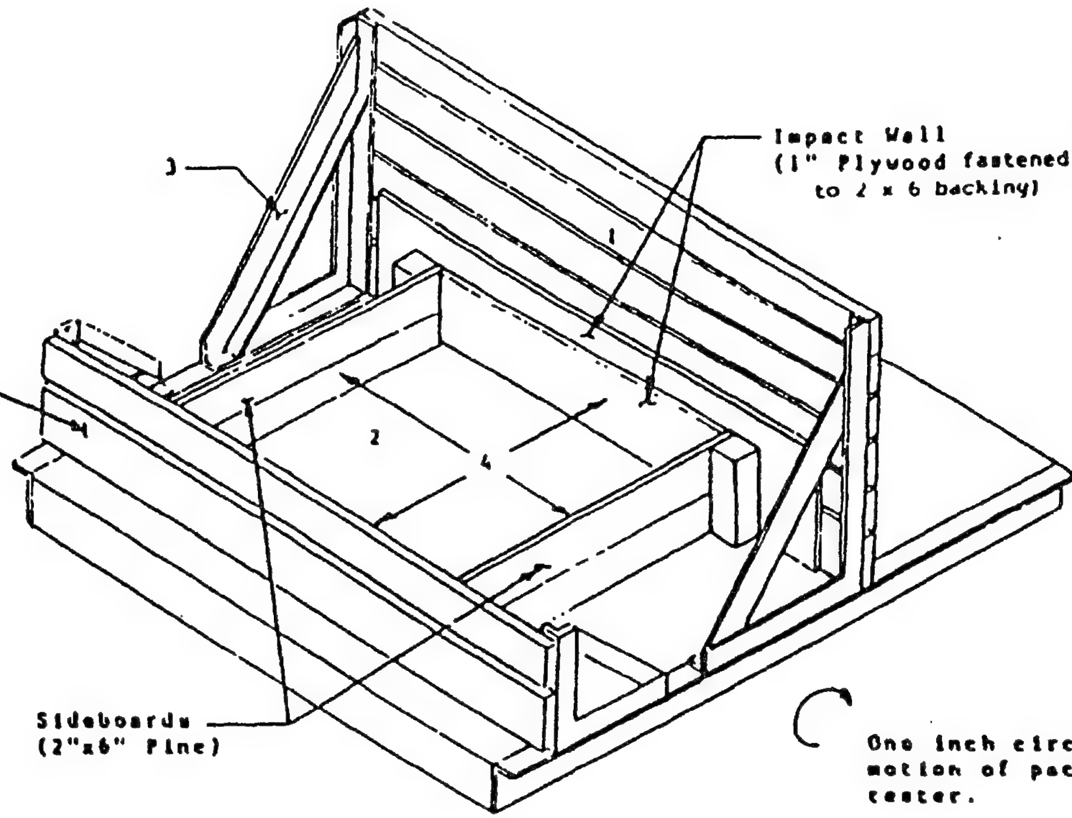
II-1.2.1.9 Category 9 - Shipboard. Equipment should be mounted in its normal configuration with normal shock/vibration isolator mounts used throughout the test.

II-1.2.1.10 Category 10 - Minimum integrity. The secured cargo transportation test phase shall be accomplished as indicated in I-3.3.1. The additional vibration exposure shall be accomplished with the test item secured to the fixture/exciter. Items which are mounted on vibration isolators should be tested with the isolation removed. The items shall be tested in each of three orthogonal axes.

II-1.2.2 Procedure II - Category 2 - Large assembly transport. The test setup uses the actual transport vehicle and test track to simulate service conditions. Secure the test item on the transport vehicle for normal transportation.

II-1.2.3 Procedure III - Category 3 -Loose cargo transport

II-1.2.3.1 Package test. The test setup uses a package tester as depicted in figure 514.4-19. The fixturing required is as shown and will not secure the item to the bed of the package tester. A vertical impact wall and sideboards as depicted in figure 514.4-19 shall be installed to contain the test items on the bed of the package tester. The fence opposite the vertical impact wall is not intended as an impact surface, but is used to restrain the test item from leaving the tester. The distance to this restraining fence should be sufficient to prevent constant impact, but still prevent one or more of multiple test items from "walking" away from the others. The height of the test enclosure (sideboards, impact wall and restraining force) should be at least 5 cm higher than the height of the test item to prevent unrealistic impacting of the test item on the top of the enclosure.



1. 2" x 6" Pine
2. 1/2" Plywood Floor
3. Angle Iron Structure
4. Test Area

FIGURE 514.4-19. Typical package tester.

II-1.2.3.2 Test bed. For testing packaged items, the test bed of the package tester shall be covered with a panel of 1/2-inch plywood, with the finished side up and the grain parallel to the drive chain. (Marine plywood is recommended because it is generally more durable.) The plywood shall be secured with bolts or six penny nails, with tops of heads slightly below the surface. The bolts or nails shall be spaced at sufficient intervals around all four edges and through the center area to prevent "oilcanning" of the plywood.

For testing of unpackaged items, the test bed of the package tester shall be covered with a steel plate, 5 to 10mm thick. The plate shall be secured to the bed of the package tester with bolts having the heads slightly below the surface. The bolts shall be spaced at sufficient intervals around all four edges and through the center area to prevent "oil canning" of the plate.

II-2 PREPARATION FOR TEST

II-2.1 General preparation

Step 1. Perform life cycle analysis described in section 4 of this standard

Step 2. Identify test categories which are applicable and pertinent from the life cycle analysis.

Step 3. Determine test conditions for each applicable and pertinent category.

Step 4. Select appropriate test apparatus, data collection and analysis equipment.

Step 5. Prepare the test item in accordance with General Requirements, paragraph 4 and as specified for the test category.

Step 6. Examine the test item for physical defects, and document the results.

Step 7. Conduct an operational check and document the results.

Step 8. Proceed to the required test procedure if no problems are found; otherwise, correct the problems and restart with step 6 above.

II-2.2 Procedure III - Loose cargo transport.

a. Packaged items. Using suitable wooden sideboards, the test item shall be constrained to a horizontal motion of 5cm (free space) in a direction parallel to the axes of the shafts - a distance more than sufficient to ensure the test item(s) will not rebound from sideboard to sideboard (i.e., the distance between sideboards shall be equal to the width of the test item plus 5cm). Initial positioning of the test item will be such that there are 2.5cm of space on either side. If more than one similar item is tested simultaneously, 2.5cm of additional free space per additional item should be used between sideboards; the initial spacing should have 2.5cm between test items and 2.5cm to each sideboard. The total free space should not exceed the length of the longest horizontal axis of the test item (to prevent test item rotation). Multiple similar test items shall not be separated by sideboards unless specified in the requirements documents.

b. Circular cross-section items. The test area on the package tester (see Figure 514.4-19) shall be square in shape. The following formula shall be used to determine the test area dimensions:

$$x = 0.767 * L * (N)^{*}$$

where:

x = length of each side of the test area
L = length of the test item
N = number of test items if N>3
For values of N ≤ 3, x ≥ 1.5 L

c. Other unpackaged test items. If the packaged item is square or rectangular in shape, use the fencing arrangement for packaged items as detailed above.

II-3 PROCEDURES

II-3.1 Procedure I

II-3.1.1 General procedure

Step 1. Complete steps 1 through 8, paragraph II-2.1.

Step 2. Inspect the test item to establish pretest criteria and physical condition.

Step 3. Verify the test item's functionality.

Step 4. Mount the test item on the vibration equipment as required by the applicable paragraph of II-1.2.1.

Step 5. Expose the test item to the test level and duration as determined from I-3.3 or I-3.4 and II-3.1.2. The test item shall be operated as if it were in operational usage. (See I-4.10, I-4.11 and I-4.12.)

Step 6. Inspect the test item and compare it to pre-test data and physical condition. Verify the test item functionality and record the results. (See I-4.11)

Step 7. Repeat steps 2 through 6 (see I-4.6) for each axis (see I-4.2.5) and each test.

Step 8. Document the test results in accordance with II-4.

II-3.1.2 Special considerations

II-3.1.2.1 Category 7A Assembled external stores, jet aircraft

Step 1. Apply broadband vibration to the store using an input spectrum shape of the store-mounted forward accelerometer response spectrum from I-3.4.4. The input level should be 6 dB down from the calculated response level of the forward accelerometer.

Step 2. Identify those frequencies at which the store-mounted accelerometers, in the direction of applied vibration, exceed the applied input vibration by 6 dB or greater. There may be different frequencies for the forward and aft accelerometers.

40-FOOT DROP TEST

Per ARRADCOM Environmental Testing Criteria (Drawing No. 8837375), a 40-foot free fall drop test was performed at ambient temperature in the following manner. With the use of two slings, the MRC, in its wooden shipping box, was elevated to a height of 40 feet 0 inches by a crane. With the aid of a helicopter quick-release mechanism, the MRC and shipping box was allowed to free fall onto a hard unyielding concrete surface, contacting the bottom surface of the shipping box. This orientation was selected due to the most likely orientation during slinging operations. Prior to the release of the shipping container, both high-speed and standard video tape cameras were started to record and document the drop test. Upon completion of the drop test, standard 35mm photos were taken to document damage to the shipping box and MRC. Prior to and upon completion of the test, helium-leak tests were conducted on the MRC to determine if the container maintained the minimum leak integrity of 1 X 10^{-6} cc/he/sec/atm. This engineering test was conducted to determine the survivability/leak integrity of the MRC after the 40-foot drop test.

PART 7

TEST RESULTS

ROAD TRANSPORTABILITY TESTS

Prior to initiating transportability tests, a helium-leak test was conducted on the SRCXX S/N EE028TB which had a leak integrity better than 1 X 10^{-6}cc/he/sec/atm. Road transportability tests were completed on 23 January 1997, with the SRCXX tested in its standard shipping box. At the beginning of the test, the container was located over the rear axle of the Commercial Utility Cargo Vehicle (CUCV) (this vehicle is similar to a standard pickup truck that would be used at formerly used defense sites [FUDS]). Times recorded during the first two passes over the road hazard course were 27 and 31 seconds, respectively. These times represent approximately 5 mph, which is required for the test plan. Following the first two passes, the shipping box moved forward and centered on the truck bed, with no damage sustained. After completing the 30-mile road trip the shipping container still remained centered on the forward section of the truck bed, again with no damage noted. Two additional passes were then completed over the road hazard course at 31 and 32 seconds, respectively, with no damage occurring to the SRCXX or its shipping box. Panic stops were conducted at 5, 10, and 15 mph and 5 mph in reverse, with no damage occurring. This test was conducted IAW the test plan to make sure that the SRCX would not be damaged during emergency stops. The washboard course was the last test conducted, and introduced severe shock into the SRCXX and shipping box to ensure no damage was sustained to the SRCXX or shipping box during severe transport. Upon completion of all transportability tests, the shipping box had sustained no damage, with the SRCXX still maintaining a leak integrity of better than 1 X 10^{-6} cc/he/sec/atm. The above tests met the requirements for ASTM-E499-73, Method B, and DAC TP-94-1.

HIGH- AND LOW-FREQUENCY VIBRATION TESTS

High-frequency vibration tests were conducted by Datasyst in Delafield, WI on the SRCXX S/N EE0028TB. Prior to high-frequency vibration testing, helium-leak testing was conducted on 29 January 1997 with the container having a leak integrity of better than 1 X 10^{-6} cc/he/sec/atm. The high-frequency test sequence was completed in the following manner: the container was preconditioned to -35 degrees Fahrenheit with 4 hours of helicopter and 1 hour of aircraft vibration completed in the longitudinal direction. The vibration spectrums for these tests were to 500 Hz for helicopter and to 2,000 Hz for aircraft. The container was then preconditioned to 165 degrees Fahrenheit with the longitudinal testing again repeated for 5 hours. After completing longitudinal testing the environmental chamber was removed with the container rotated 90 degrees for hot and cold lateral testing. The environmental chamber was reinstalled with the container again preconditioned to -35 degrees Fahrenheit followed by 5 hours of vibration testing. After completing this cycle, the test sample was preconditioned to 165 degrees for the final 5 hours of testing. Total time for high-frequency vibration testing was 20 hours. Upon test completion, the container was inspected for damage and helium-leak tested. The general condition of the container was still good with it maintaining a leak integrity of at least 10^{-6} cc/he/sec/atm. See part 8 for graphs depicting the high-frequency vibration testing. On 6 March 1997, the SRCXX S/N EE028TB was again preconditioned to -35 degrees Fahrenheit for the low-frequency vibration test. This test was conducted at 5 hz for a period of 20 minutes during which time severe shock was introduced into the container body. Following this test the container was helium-leak tested with it still maintaining its leak integrity of at least 10^{-6} cc/he/sec/atm. The container was then preconditioned to 165 degrees Fahrenheit followed by another 5 hz 20 minute low-frequency vibration test. After all vibration tests were completed, the container still maintained a leak integrity of better than 1 X 10^{-6} cc/he/sec/atm. The above tests met the requirements for ASTM-E499-73, Method B, and MIL-STD 810E, Method 514.4.

UNITED NATIONS (UN) PERFORMANCE ORIENTED PACKAGING (POP) TESTS.

UN POP tests were conducted on the SRCXX S/N EE0028TB. Prior to and immediately following each test, the container was helium-leak tested to ensure leak integrity. The compression test was conducted 3 March 1997 at 2,000 pounds for a period of 24 hours. End of test inspection indicated no damage, with the container still maintaining its leak integrity. Vibration tests were conducted on 25 February 1997 in the following orientations: parallel, lateral, and vertical directions to the container body. Each test lasted 1 hour per orientation. After completing all tests, the container had no damage to the container body, and still maintained its leak integrity. Hydrostatic tests were conducted on 3 March 1997 on S/N EE0028TB at a pressure of 60 psi for 3 minutes, no leaks occurred. The pressure was increased to 200 psi for an additional 3 minutes with the container not leaking. Drop tests were conducted on S/N EE0028TB on 25 February 1997 from 5.9 feet. Following each drop, helium-leak testing was performed. The first three drops were longitudinal to the container body, impacting on the seam weld. After each drop, helium-leak tests were conducted with the container maintaining a leak integrity of better than 1 X 10^{-6} cc/he/sec/atm. The next three drops were 45 degrees to the container flange/lid directly in line with a bolt. After each drop the container was rotated approximately 45 degrees to avoid impacting the same area on the container lid. On the first drop at 45 degrees no leaks were detected; however, after the second drop a slight leak in the 10^{-5} cc/he/sec/atm range was detected. The container flange was cleaned, a new gasket installed and the bolts were tightened and the leak disappeared. To complete the required six drops with no leaks, this container was dropped a sixth and seventh time with no leaks detected. Hot and cold drop tests were also completed 7 March 1997 on S/N EE0028TB, with no leaks detected at 165 degrees Fahrenheit or -35 degrees Fahrenheit after testing. The above tests met the requirements for ASTM-E499-73, Method B, and UN POP Title 49CFR, Section 178.6.

40-FOOT DROP TEST

This engineering test was conducted 22 April 1997 on SRCXX S/N EE0028TB. Prior to the drop test, helium-leak tests were performed, with this container having a leak integrity of at least 1×10^{-6} cc/he/sec/atm. Total drop weight during this test was 400 pounds which included the SRCXX (135 pounds) plus wooden shipping container (70 pounds) manufactured by Teledyne Brown Engineering. After free falling from 40 feet and impacting a concrete surface, extensive damage was sustained to the container sidewall at points of contact with the 2- by 4-inch wooden cradles (see photos in Part 10). Although damage was noted to the container sidewalls it still maintained a leak integrity of at least 1×10^{-6} cc/he/sec/atm. To avoid damage in the future, new production should include a redesigned cradling system.

PART 8

UN POP TESTS (STANDARD FORM)

SRCXX United Nations (UN) Performance Oriented Packaging (POP) Tests

U.S. Army Defense Ammunition Center

SIOAC-DEV, 3700 Army Depot Road, Savanna, IL 61074-9639

815-273-8908

Jerome H. Krohn

Test Report Number: 97-03	Service Code: DEV
Product NSN: N/A	Nomenclature: SRCXX
Shipping Name: *	UN ID Number: *
Hazard Class: Poison 2.3, 6.1 and/or Explosive 1.2K	Packing Group: I
Physical State: *	NALC/DODAC: *
CAA Number: *	EX Number: *
CFR 49 Packaging Method: E-102	
Net Explosive Weight: *	

DESCRIPTION OF PACKAGINGS TO BE TESTED

EXTERIOR CONTAINER

Exterior Container: Drum (Removal Head)

CFR 49 Reference Number: 173.7A

UN Code: 1A2

* See Interim Hazardous Classification for following items.

NSN Exterior Container:

Specifications: 1A2

Drawing Number: 15-12-422, 15-12-443, 15-12-444, 15-12-445, 15-12-446, 15-12-447, 15-12-448, 15-12-511

Net Quantity Weight: 205 lbs (93 kg)

Tested Gross Weight: 340 lbs (155 kg)

Dimensions Interior: L-51-1/4" X D-11-3/4"

Manufacturer: Teledyne Brown Engineering

Year Container Manufactured: 1996

Drawing Number(s): 15-12-442

Cushioning: Vermiculite

Closure: 10 Bolts

INTERMEDIATE CONTAINER

Intermediate Container Description: None

Specification Number: N/A

Container NSN: N/A

Intermediate Container Cushioning: N/A

Intermediate Container Closure Method: N/A

Intermediate Container Dimensions: N/A

Number Of Intermediate Containers: N/A

UNIT CONTAINER

Unit Container Description: None

Unit Container Specification: N/A

Unit Container NSN: N/A

Unit Container Cushioning: None

Unit Container Closure Method: N/A

Unit Container Dimensions: N/A

Number of Unit Containers: N/A

SPECIAL NOTES

All exterior, intermediate, and unit containers must be inspected prior to use. Inspect for physical damage,structural integrity and leak proofness of the containers.

SUPPLEMENTAL INFORMATION

Permitted Transportation Modes: Military or DOD licensed truck,
Military or DOD licensed aircraft.

Specific Gravity: N/A

Hydrostatic Test Pressure Applied: 60 PSI

Leakproofness Test Applied: Helium Leak Test at 1 X 10 $^{-6}$cc/he/sec/atm

TEST PROCEDURES

Tests Conducted	Test Method	Test Results
(1) Pre-Conditioning (fiberboard)	Part 178.602	N/A
(2) Drop Test	Part 178.603(e)(1)(ii)	Pass
(3) Leakproofness Test (1 X 10 $^{-6}$cc/he/sec/atm)	Part 178.604	Pass
(4) Hydrostatic Pressure Test (60 PSI)	Part 178.605	Pass
(5) Stacking Test (2,000 lbs)	Part 178.606(c)(1)	Pass
(6) Vibration Test	Part 178.608(b)(3)	Pass

UN POP Marking

u 1A2/X155/S/96

n USA/DOD/DEV

CERTIFICATION

Unless expressly stated to the contrary, we certify that all of the above applicable tests have been performed in strict conformance to CFR 49, Subpart M, Parts 178.600 - 178.608. Based on the successful test results shown above, this container is deemed suitable for transport of the hazardous material described herein, provided that maximum tested weights and quantities are not exceeded and the packaging is assembled as tested. The use of other packaging methods or components may make this test invalid.

PREPARED BY: William R. Meyer DATE: 6-24-98
WILLIAM R. MEYER
Test Engineer

PREPARED BY: Bradley J. Haas DATE: 6-24-98
BRADLEY J. HAAS
Test Engineer

SUBMITTED BY: Jerome H Krohn DATE: 6/24/98
JEROME H. KROHN
Chief, Validation Engineering Division

APPROVED BY: Thomas J Michels DATE: 6/24/98
WILLIAM F. ERNST
Chief, Logistics Engineering Office

PART 9

SPECIAL PACKAGING INSTRUCTIONS (SPI)

SPECIAL PACKAGING INSTRUCTIONS (AMCCOM Suppl 1 to AR 700-15)	1. NATIONAL STOCK NUMBER N/A

2. SPI NO	3. REVISION	4. DATE
(AD) P 1365 ESK/MRC-2		20 AUGUST 1997

5. PART OR DRAWING NO	6. FSCM	7. MIL-P-116 CLEANING/DRYING
P/N VARIES W/CNTR. SEE CHART ON PAGE 2	59678	-

8. QUP/UNIT OF ISSUE	9. ICQ	10. UNIT PACK WEIGHT (APPROX LB)	11. UNIT PACK CUBE (EXT) (APPROX FT)	12. UNIT PACK SIZE (EXT) (APPROX FT)
* / EA.	-	*	*	*

13. LEVEL A UNIT PACK REQUIREMENTS

MIL-P-116 METHOD ______	STEPS	DRAWING OR SPECIFICATION	STYLE	TYPE	GRADE	CLASS	SIZE (INSIDE DIMENSIONS IN INCHES) AND REMARKS
BAG, ITEM, PLASTIC	1	PPP-B-26					SIZE TO FIT CNTR. USED
CNTR. LINER (PLASTIC)	2	PPP-B-26					29.25" X 9" DIA. (1 EA.)
CUSHION (VERMICULITE)	3	MIL-V-21826					AS REQD.
PAD (FIBERBOARD	4	ASTM-D 4727					AS REQD.
SRC/MRC (SHIPPING CNTR)	5	SEE CHART PAGE 2					1 EA.
CLOSURE	6	TORQUE BOLTS					NA
WDN BOX (OVERPACK)	7	SEE CHART PAGE 2					1EA.
CLOSURE	8	LATCH/WIRE-TWIST					AS REQD.
LEAD SEAL	9	8794642					1 EA.

14a. LEVEL B: METHOD ________ [X] NOT APPLICABLE [ ] SEE NOTE ________

14b. LEVEL C: METHOD ________ [X] NOT APPLICABLE [ ] SEE NOTE ________

15. INTERMEDIATE PACKAGING AND PACKING WILL BE IN ACCORDANCE WITH SPECIFICATION MIL-STD-2073-1 OR AS OTHERWISE SPECIFIED HEREON.

16. MARKING WILL BE IN ACCORDANCE WITH MIL-STD-129.

17. SPECIFICATIONS, STANDARDS, AND DRAWINGS LISTED HEREON OF THE ISSUE IN EFFECT ON DATE OF INVITATION FOR BID FORM A PART OF THIS DATA SHEET. THE APPLICABLE GENERAL AND REFERENCED REQUIREMENTS OF SPECIFICATION MIL-STD-2073-1 FORM PART OF THIS DATA SHEET. UNLESS OTHERWISE SPECIFIED, MATERIALS WILL BE MINIMUM SIZE IAW MIL-STD-2073-1.

18. TOLERANCES SHALL BE IN ACCORDANCE WITH MATERIAL SPECIFICATIONS. QUALITY PERFORMANCE AND TESTING REQUIREMENTS SHALL BE IN CONFORMANCE WITH MIL-P-116 OR AS OTHERWISE SPECIFIED HEREON.

19. NOTES/DRAWINGS * WILL CHANGE WITH ITEM PACKAGED

A. THIS SPECIAL PACKAGING INSTRUCTION (SPI) IS PREPARED FOR USE BY THE PROJECT MANAGER (PM) FOR NON-STOCKPILE CHEMICAL MUNITIONS IN THE REPACKAGING OF CHEMICAL, TOXIC AND/OR EXPLOSIVE MATERIAL FOR TRANSPORT BY THE U.S. EXPLOSIVE ORDNANCE DISPOSAL (ORD) OR ARMY TECHNICAL ESCORT UNIT (TEU) FROM FORMERLY USED DEFENSE (FUD) SITES TO AN APPROVED STORAGE AND DISPOSAL FACILITY (ASDF) (FOLLOWING IDENTIFICATION OF THE (ITEM) IN A PERFORMANCE ORIENTED PACKAGING (POP) (UN PACKING GROUP I) TESTED CONTAINERS OF VARIOUS SIZES IN ACCORDANCE WITH (IAW) UN PACKING INSTRUCTION: PI-101, WHEN ACCOMPANIED WITH AN INTERIM HAZARD CLASSIFICATION (IHC) OR (USATCES) SAFETY LETTER FOR UNKNOWN/UNIDENTIFIABLE (WORST CASE) ITEMS. SHIPPING PAPERS OF ALL TOXIC CHEMICAL SHIPMENTS HAVING A UN SERIAL/INDEX NUMBER OF UN 0020 MUST BE ACCOMPANIED WITH CERTIFICATION OF EQUIVELANCY (COE) CCN AY 96-48 FOR IN COUNTRY SHIPMENT OR BY OBTAINING A COMPETANT AUTHORITY APPROVAL (CAA) FOR OCONUS (OR CONUS) ATTACHED TO SHIPPING PAPERS OF EACH SHIPMENT. (SEE CHART ON PAGE 2).

B. PACKAGING: PLACE BAG LINER (STEP 1) INTO MRC (STEP 5) AND ADD ONE (1") INCH OF CUSHIONONG (STEP 3) INTO BAG FOLLOWED BY ONE (1) ITEM (PROJECTILE, BOMB, ETC.) ADD VERMICULITE CUSHIONING (STEP 3) INTO BAG LINER TO COVER ITEM(S) TO A DEPTH OF ONE INCH OF (STEP 3).

(SEE CHART ON PAGE 2 OF 2.)

20. ITEM IDENTIFICATIONS CODE(S)	21. ITEM SIZE	22. ITEM WT	23. APPROVED
	*	*	David A. Peskoil

24. NOMENCLATURE	25.
SRC/MRC (VARIOUS SIZES-ANY ITEM)	PAGE 1 OF 3 PAGES

SPECIAL PACKAGING INSTRUCTION (Continued)

NATIONAL STOCK NUMBER	SPI NUMBER (PN)
N/A	(AD) P 1365 ESK/MRC-2

B. (CONTINUED)

(IF MORE THAN ONE ITEM IS PACKED IN THE SAME MRC CONTAINER, INSERT A FIBERBOARD PAD (STEP 4) AND ADD ONE (1") INCH OF VERMICULITE CUSHIONING (STEP 3) BEFORE INSERTING THE SECOND ITEM. INSERT ITEM AND COVER ITEM WITH CUSHIONING (STEP 3) TO A DEPTH OF ONE (1") INCH OR MORE). ADD CUSHION AS REQUIRED TO FILL BAG AND CLOSE AND SEAL THE BAG LINER (STEP 4) BY REMOVIN EXCESS AIR AND FOLDING, TAPING OR HEAT SEALING BAG. ADD TOP PADS (STEP 4) AS REQUIRED TO FORM TIGHT PACK AND CONTACTING THE CONTAINER LID (STEP 5) AT CLOSURE. SEAL THE MRC IAW THE CBDC SOP (STEP 6) AND PLACE MRC (STEP 5) IN THE WOODEN OVER PACK CONTAINER (STEP 7). CLOSE OVERPACK LID AND LATCHESAND INSERT WIRE TWIST (STEP 8) AND PLACE A LEAD WIRE SEAL (STEP 9-OPTIONAL) IN THE RIGHT SIDE LATCH.

C. MARK IN ACCORDANCE WITH MIL-STD-129-N AND AND AS A MINIMUM:

MANAGEMENT CONTRO;L NUMBER (MCN)
QTY/NOMINCLATURE
PACK GROSS WEIGHT
DWG./SPI): "(AD) P 1365 ESK/MRC-2"
COE/CCN AY 97-49

THE PROPER SHIPPING NAME MAY CHANGE WITH EACH ITEM PACKED. THE EXPLOSIVE HAZARD LABLE IS 1.2K OR AS SHOWN IN THE INTERIM HAZARD CLASSIFICATION TO BE CARRIED WITH SHIPPING PAPERS OF EACH SHIPMENT.

D. THE PERFORMANCE ORIENTED PACKAGING (TEST) MARKINGS ARE AS FOLLOWS:

u n 1A2/X + /S/** — ** = INSERT LAST TWO DIGITS OF YEAR PACKED
USA/DOD DEV — + = SEE CHART ON PAGE 3

NOMENCLATURE	PAGE NUMBER	NUMBER OF PAGES
SRC/MRC (VARIOUS SIZES-ANY ITEM)	2	3

SPECIAL PACKAGING INSTRUCTION (Continued)

NATIONAL STOCK NUMBER	SPI NUMBER (PN)
N/A	(AD) P 1365 ESK/MRC-2

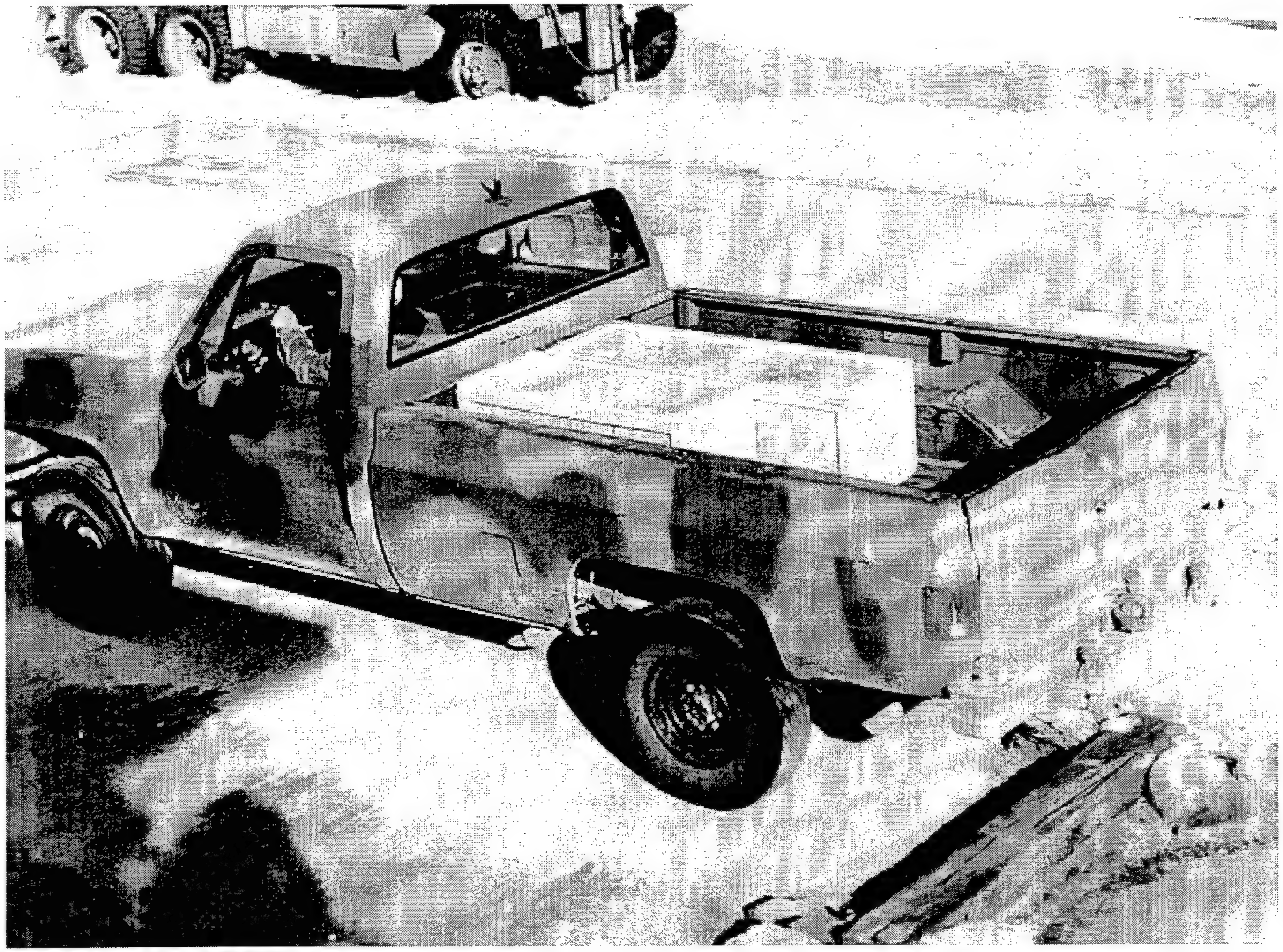
	(I.D.) SIZE		a = CNTR b. = OVERPACK		+ POP TEST WEIGHTS	DESIGNED TO CONTAIN THE FOLLOWING ITEMS
CONTAINER	DIA.	LENGTH	DWG. NO.	EMPTY WT.		
MRC (SMALL RRS TYPE)	7"	27.0"	a. ACV-00500 b. ACV-00560	55 lbs. 45 lbs	70.5 Kg —	4.2 MORTAR 75 MM PROJ. 4.7 MM PROJ. 2.63 ROCKET 155 MM PROJ
MRC (MEDIUM)	9"	41.0"	a. ACV-00507 b. ACV-0074-6	100 lbs 75 lbs	141 Kg. —	LEVENS PROJ. 175 MM PROJ. 8" PROJ. 155 MM PROJ.
SRC X	11.75"	37.50"	a. 15-12-442 b. ACV-577-79	120 lbs 70 lbs.	148 Kg. —	LEVENS PROJ 4.2" MORTAR 8" PROJ. 155 MM PROJ.
SRC XX	11.75"	51.25'	a. 15-12-443 b. ACV-588-90	135 lbs. 60 lbs.	155 Kg. --	CAIS PIGS M47 lb BOMB 175 MM PROJ. 8' PROJ.
MRC (SMALL BOMB)	12"	56.0"	a. ACV-00566 b. ACV-00580-82	150 lbs. 110 lbs.	164 --	CAIS PIGS BOMB CHEM. 115/125 lb E46, E52, M70 & M113
MRC (VX MINE)	16.50"	5.5 "	a. TBD b.	TBD	TBD	MINE AGENT M23 MINE CHEM (1 GAL)

+ = SEE CHART ABOVE FOR MRC CONTAINER, LOAD AND POP WEIGHT INFORMATION

NOMENCLATURE	PAGE NUMBER	NUMBER OF PAGES
SRC/MRC (VARIOUS SIZES-ANY ITEM)	3	3

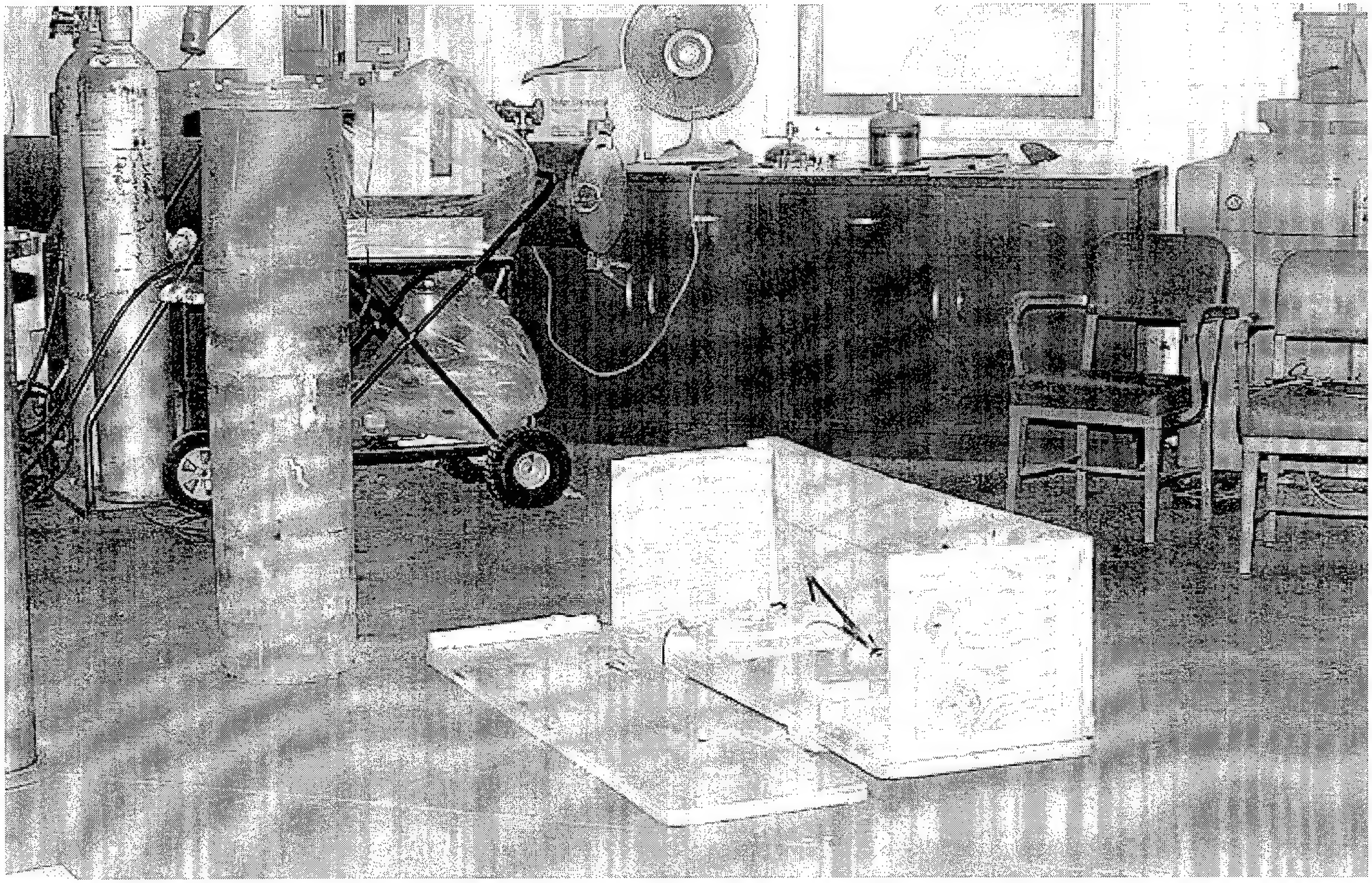
PART 10

PHOTOGRAPHS



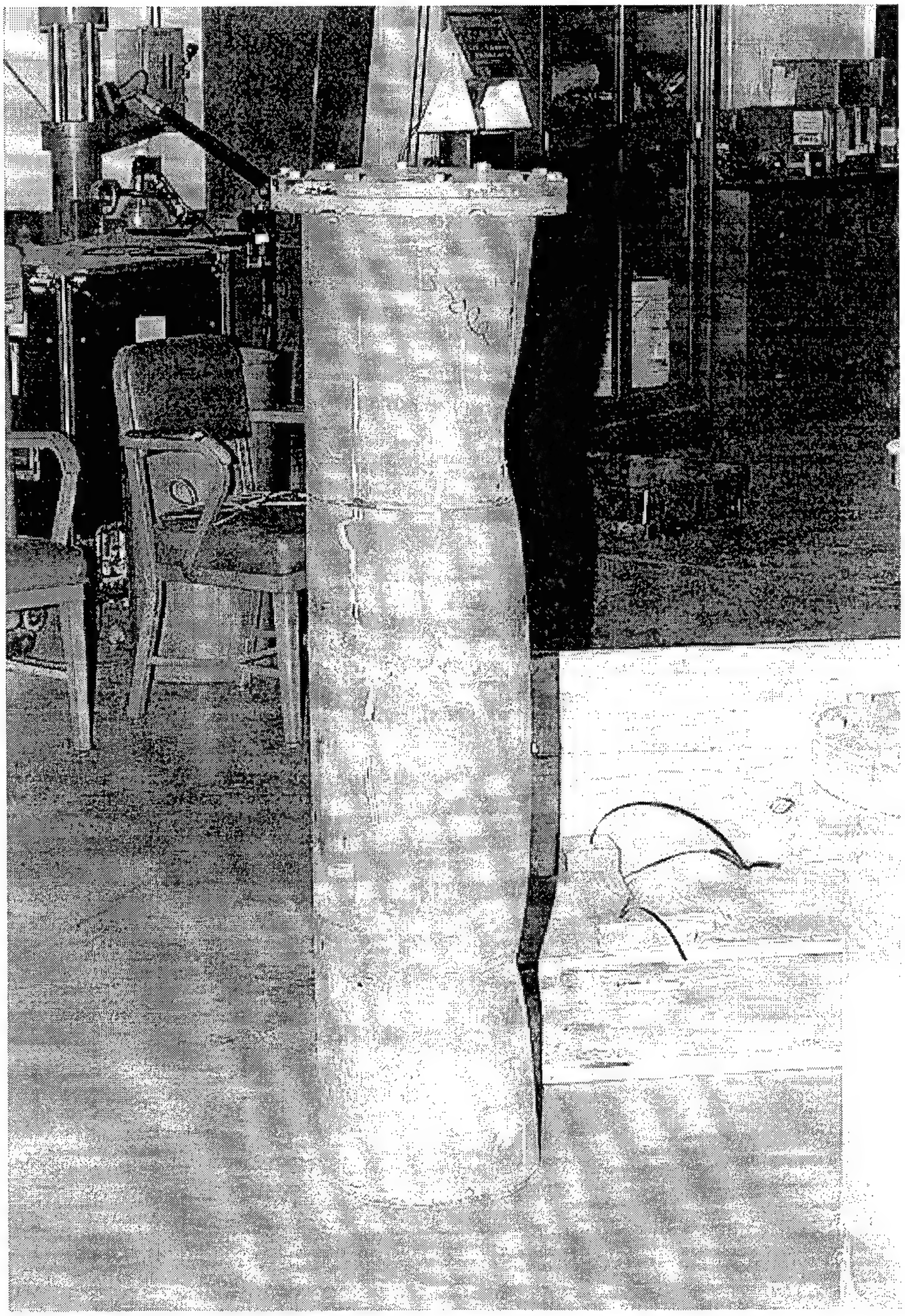
U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-97-701. This photo shows an overall view of the SRCXX in it's shipping box during road transportability tests. Note: smaller wooden box contains the SRCX.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

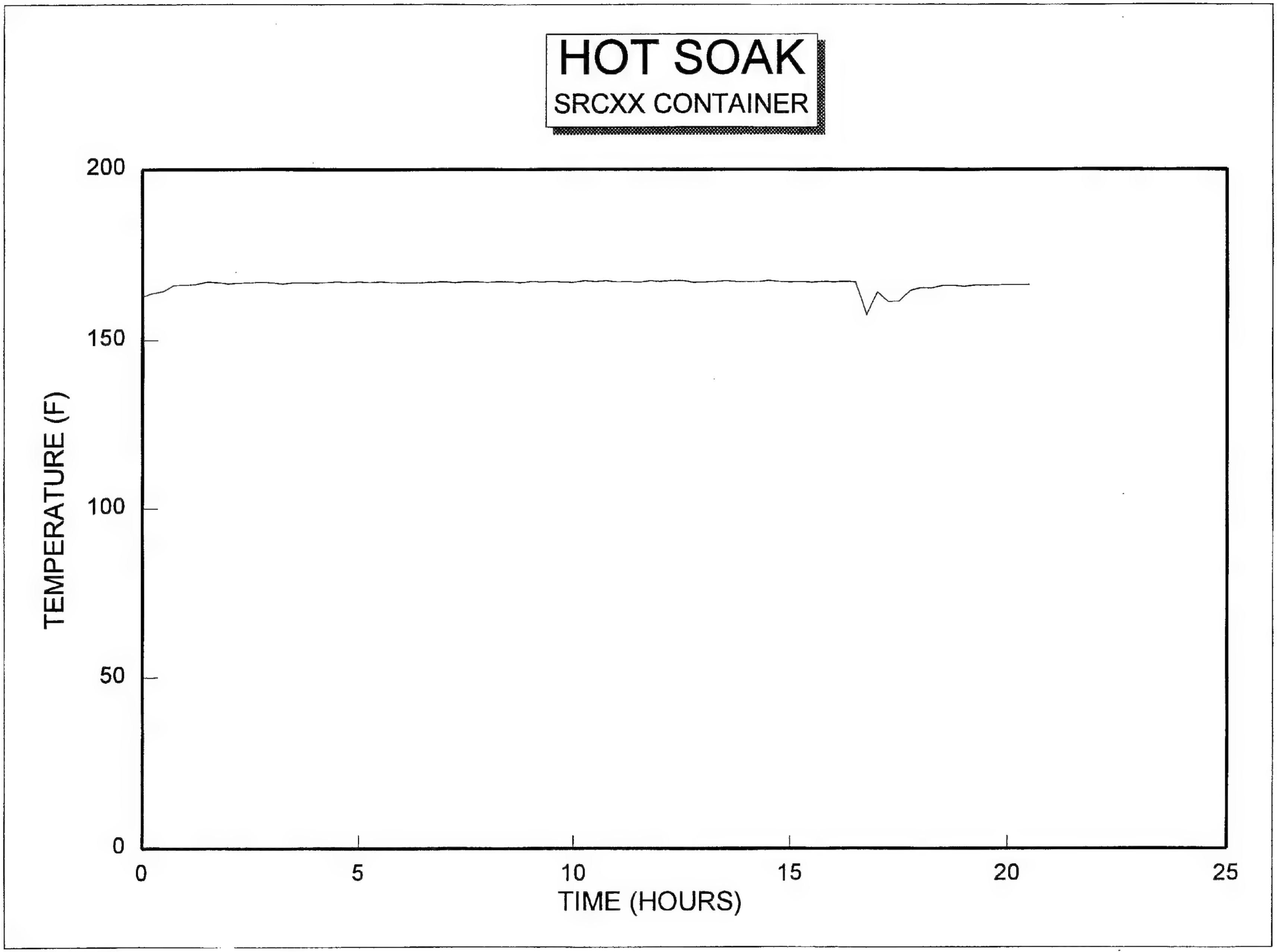
DAC-97-03-01. This photo shows an overview of the SRCXX after testing.

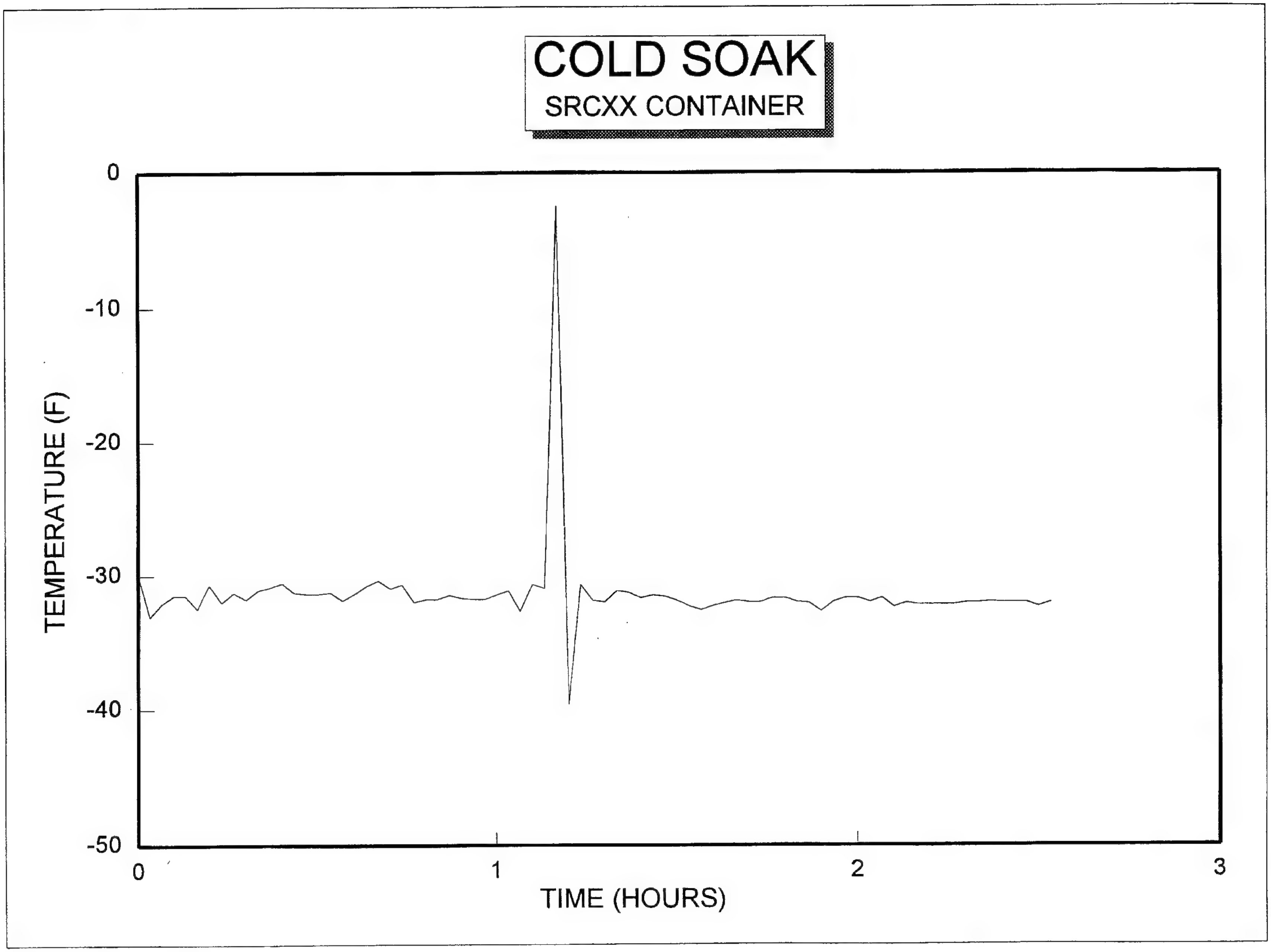


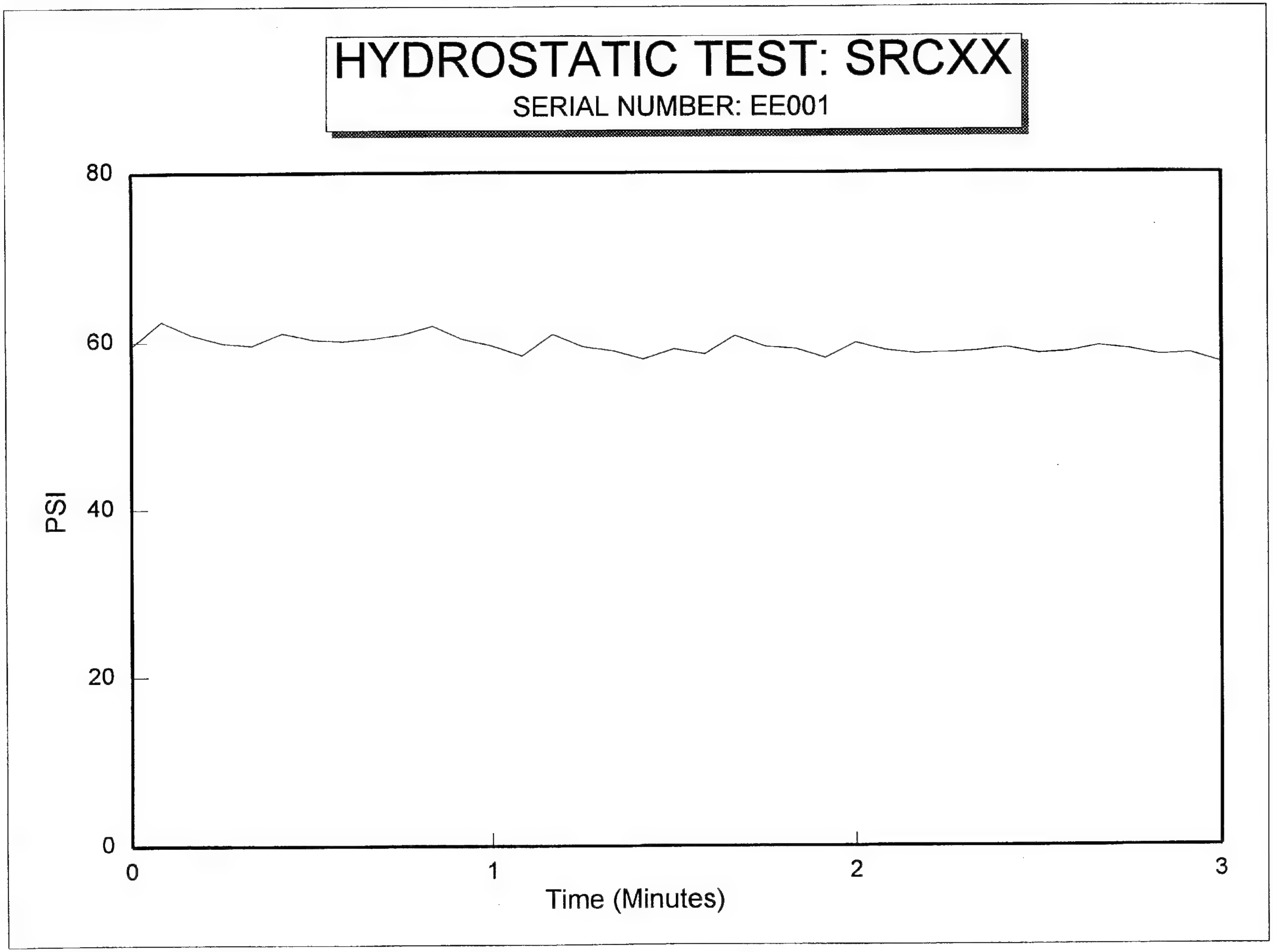
	U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL	
PHOTO NO. DAC-97-03-02. This photo shows damage sustained to the SRCXX after the 40-foot drop test.		

PART 11

GRAPHS


HOT SOAK
SRCXX CONTAINER
TEMPERATURE (F)
200
150
100
50
0
0
5
10
15
20
25
TIME (HOURS)


COLD SOAK
SRCXX CONTAINER
TEMPERATURE (F)
0
-10
-20
-30
-40
-50
0
1
2
3
TIME (HOURS)


HYDROSTATIC TEST: SRCXX
SERIAL NUMBER: EE001
PSI
80
60
40
20
0
0
1
2
3
Time (Minutes)

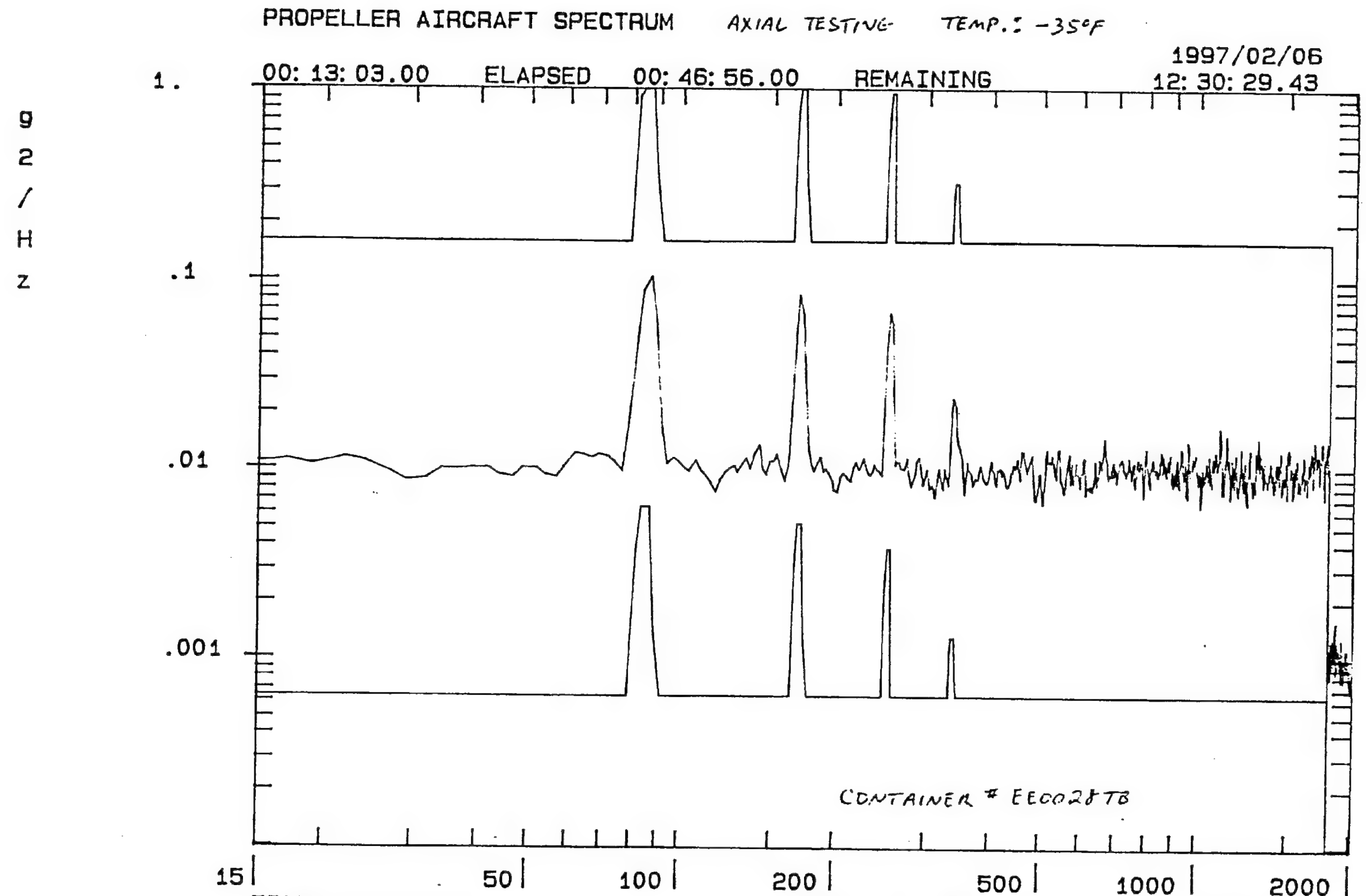


FIGURE 514.4-17

TOTAL g rms 4.47

UNIT 1, TEST 6
2000 Hz BANDWIDTH
CONTROL

LOG X-AXIS
800 LINES
154 D.O.F

VIBRATION PROFILE FOR HELICOPTERS AXIAL TESTING TEMP.: -35°F

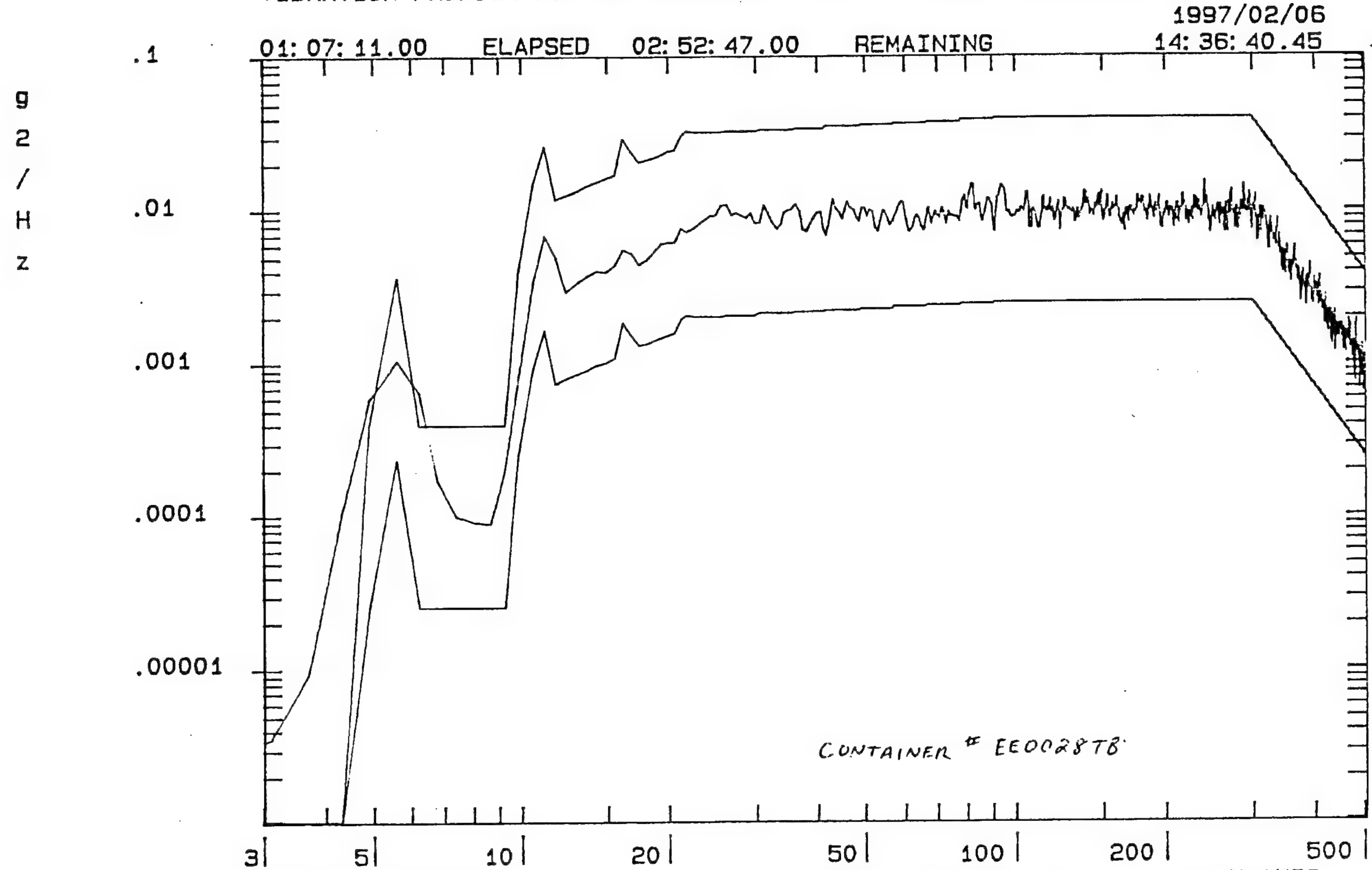
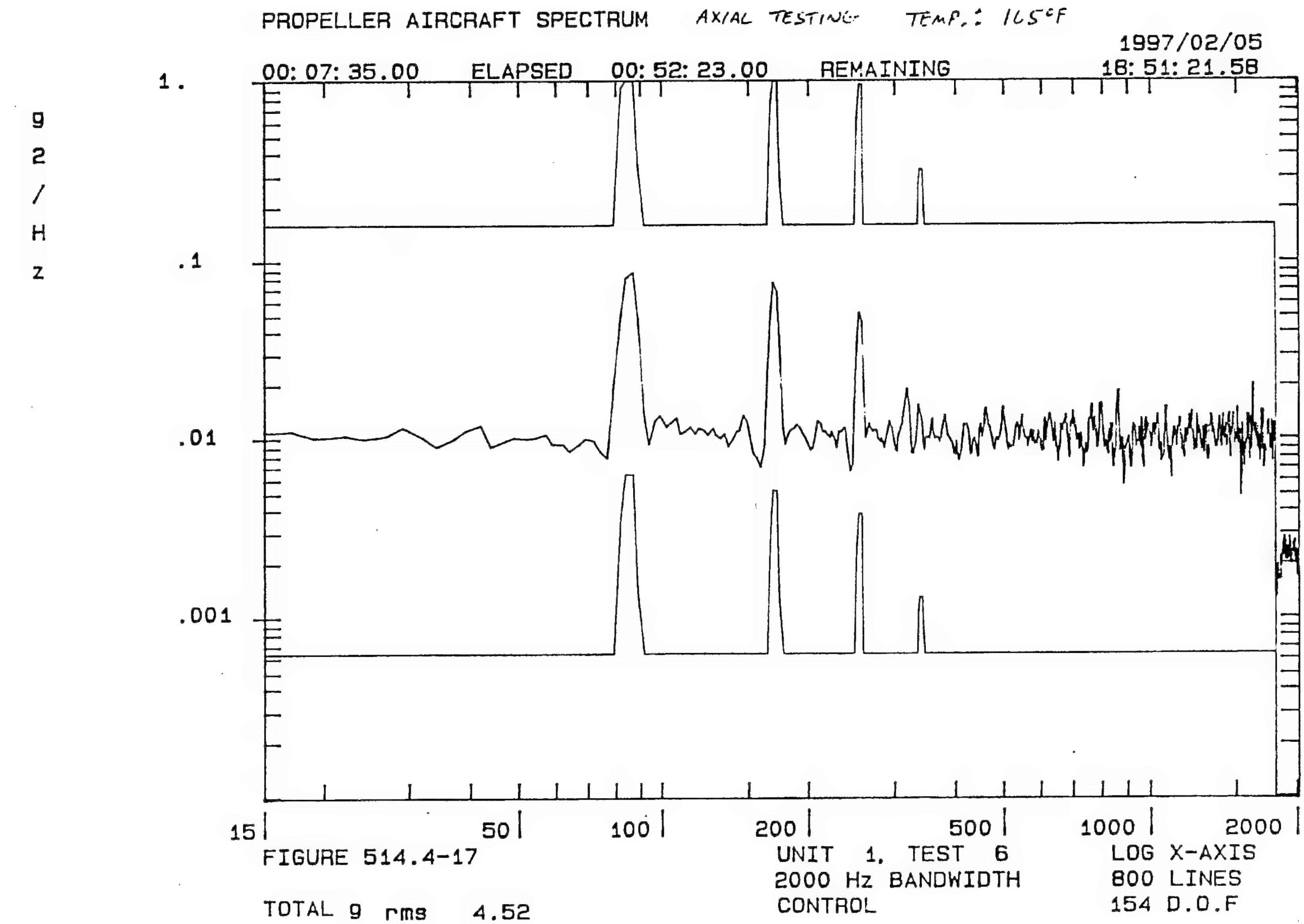


FIGURE 514.4-22

TOTAL g rms 1.88

UNIT 1, TEST 5
500 Hz BANDWIDTH
CONTROL

LOG X-AXIS
800 LINES
154 D.O.F


PROPELLER AIRCRAFT SPECTRUM
AXIAL TESTING
TEMP.: 165°F
1997/02/05
00: 07: 35.00 ELAPSED 00: 52: 23.00 REMAINING
18: 51: 21.58
g2/Hz
1.
.1
.01
.001
15
50
100
200
500
1000
2000
FIGURE 514.4-17
TOTAL g rms 4.52
UNIT 1, TEST 6
2000 Hz BANDWIDTH
CONTROL
LOG X-AXIS
800 LINES
154 D.O.F

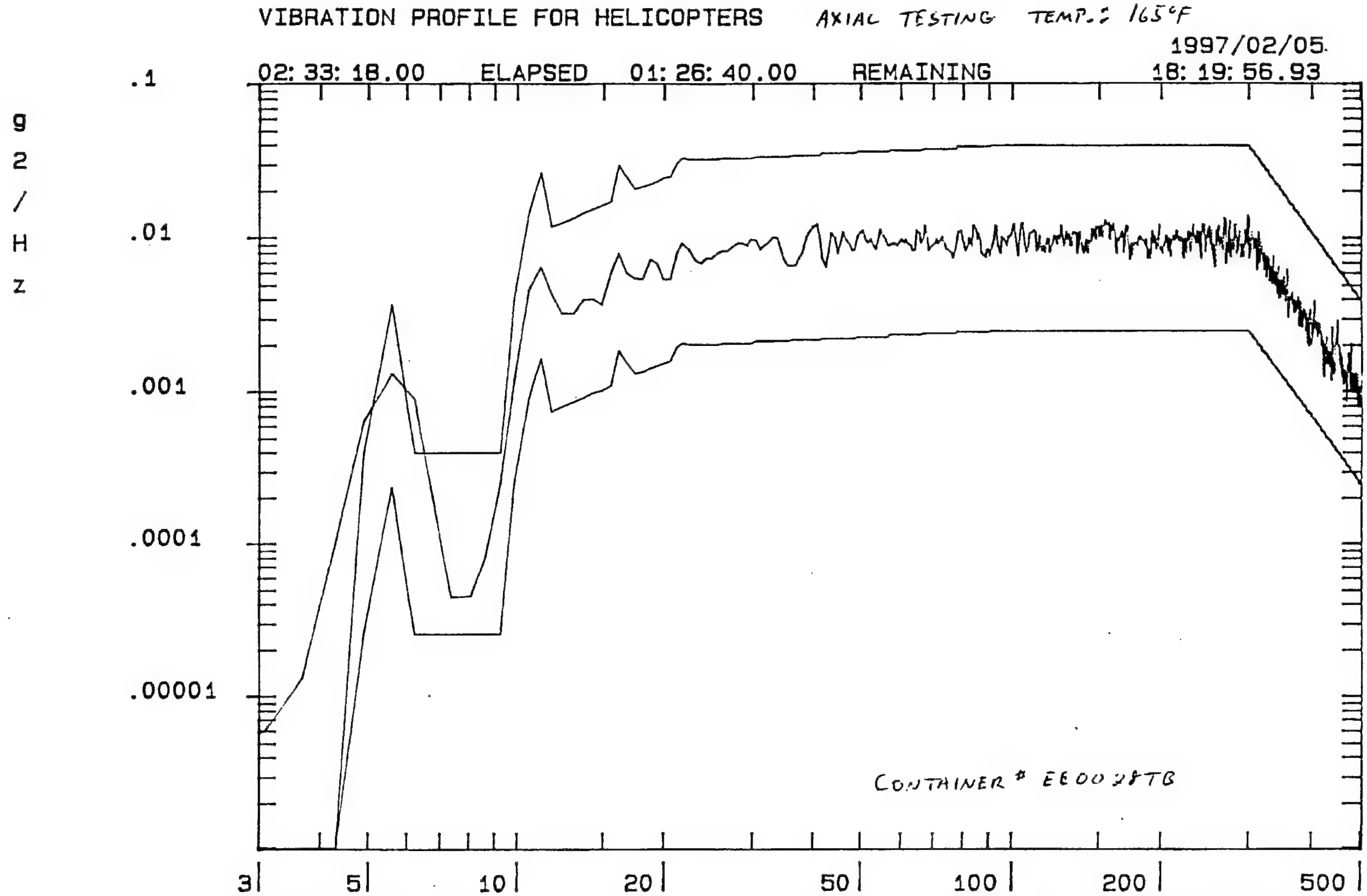
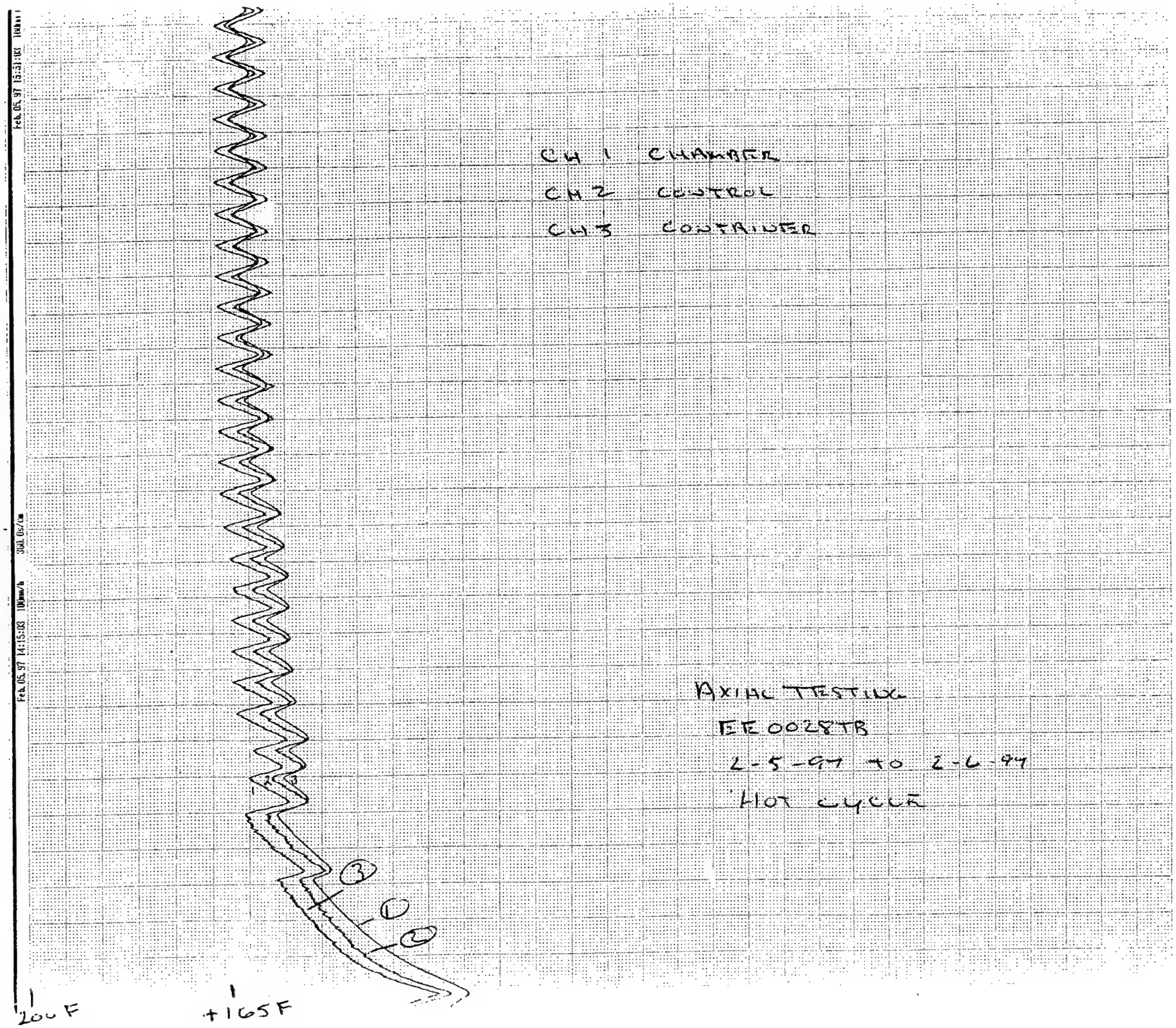
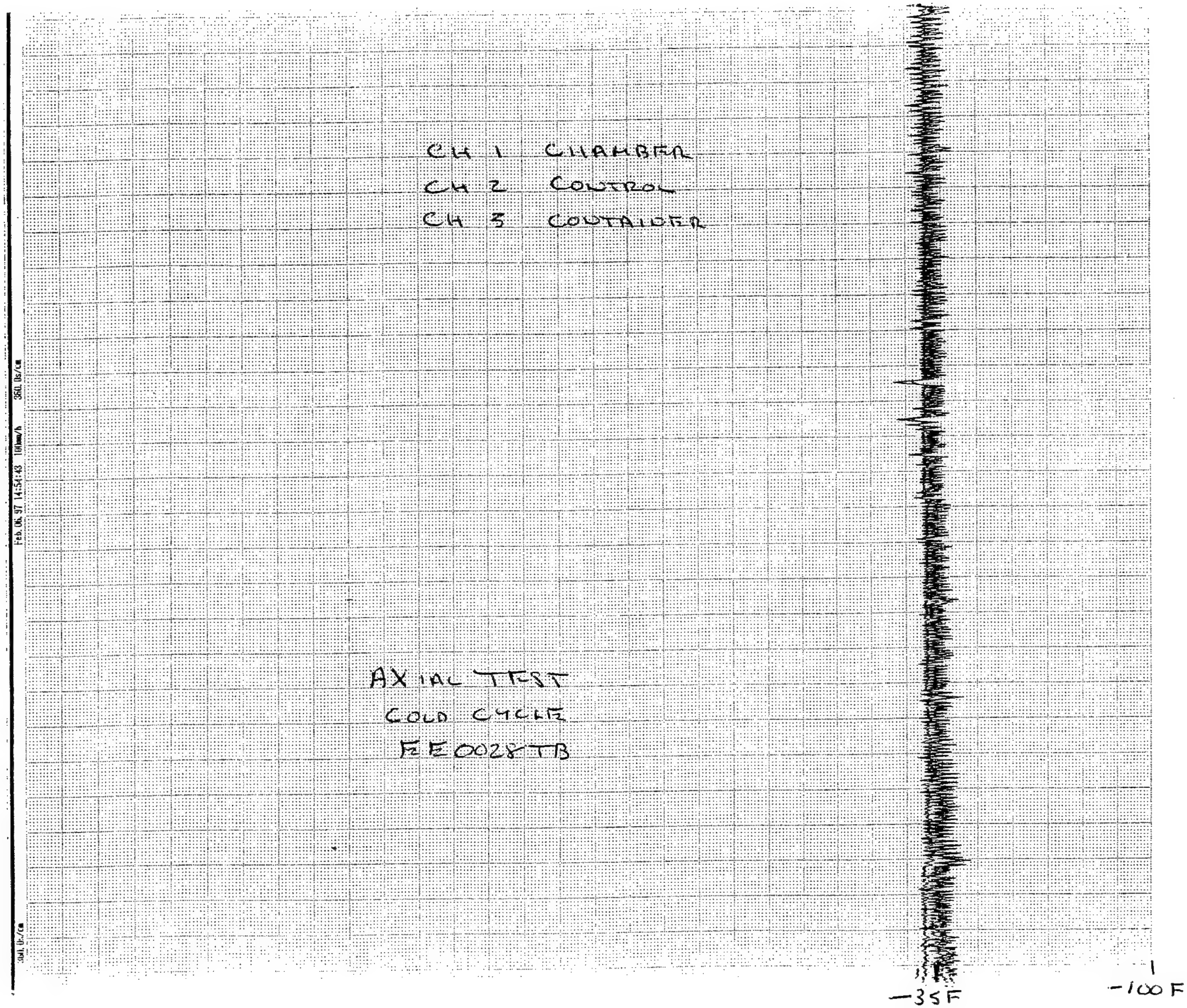


FIGURE 514.4-22

TOTAL g rms 1.86


Feb. 05. 97 15:51:03
Feb. 05. 97 14:15:03 100mm/h 360. 0s/cm
CH 1 CHAMBER
CH 2 CONTROL
CH 3 CONTAINER
AXIAL TESTING
EE0028TB
2-5-97 to 2-6-97
HOT CYCLE
3
1
2
200 F
+165 F



CH 1 CHAMBER
CH 2 CONTROL
CH 3 CONTAINER
AXIAL TEST
COLD CYCLE
FE0028TB
-35F
-100F
Feb.06.97 14:54:43 100mm/h 360.0s/cm

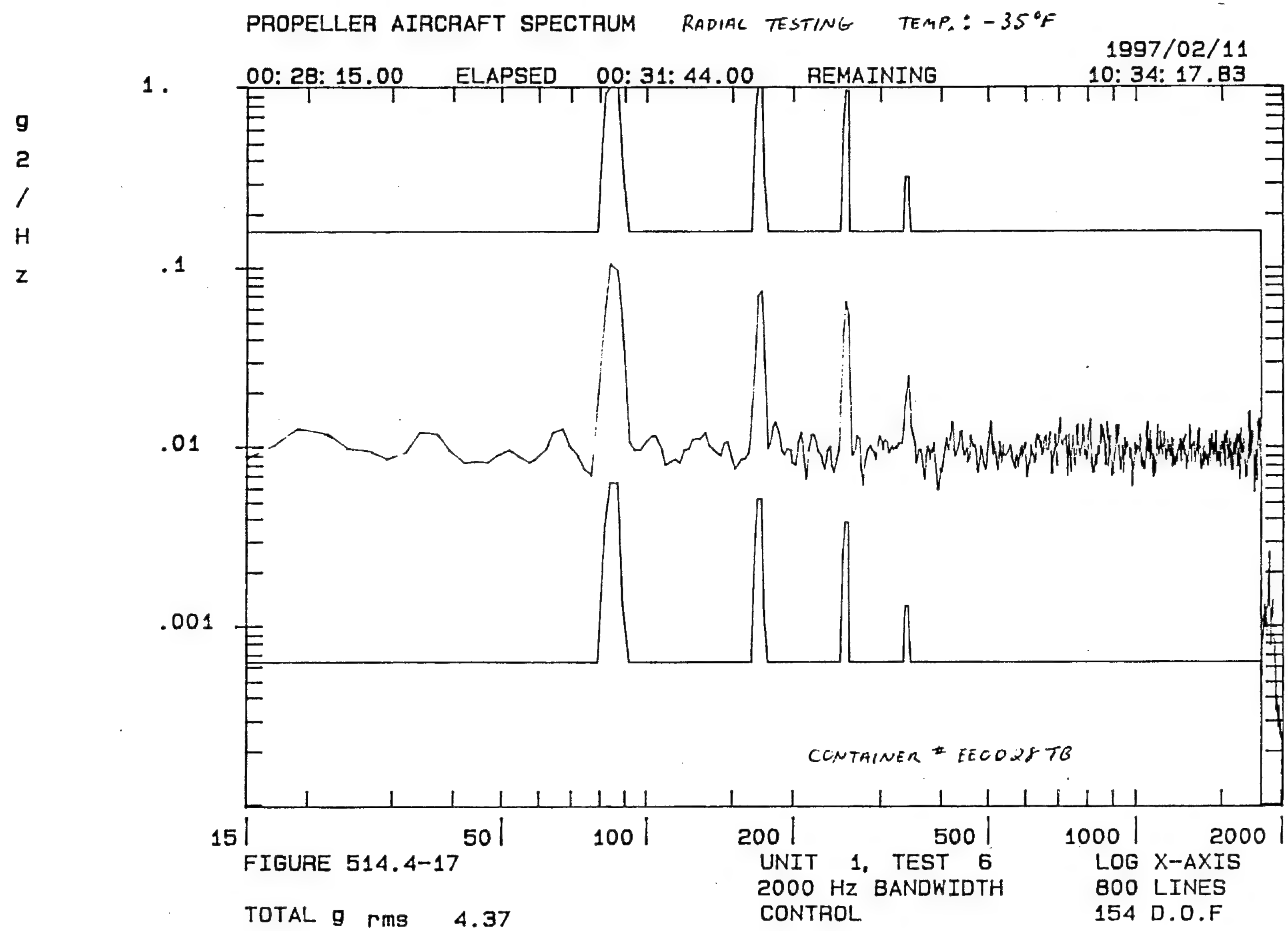


FIGURE 514.4-17

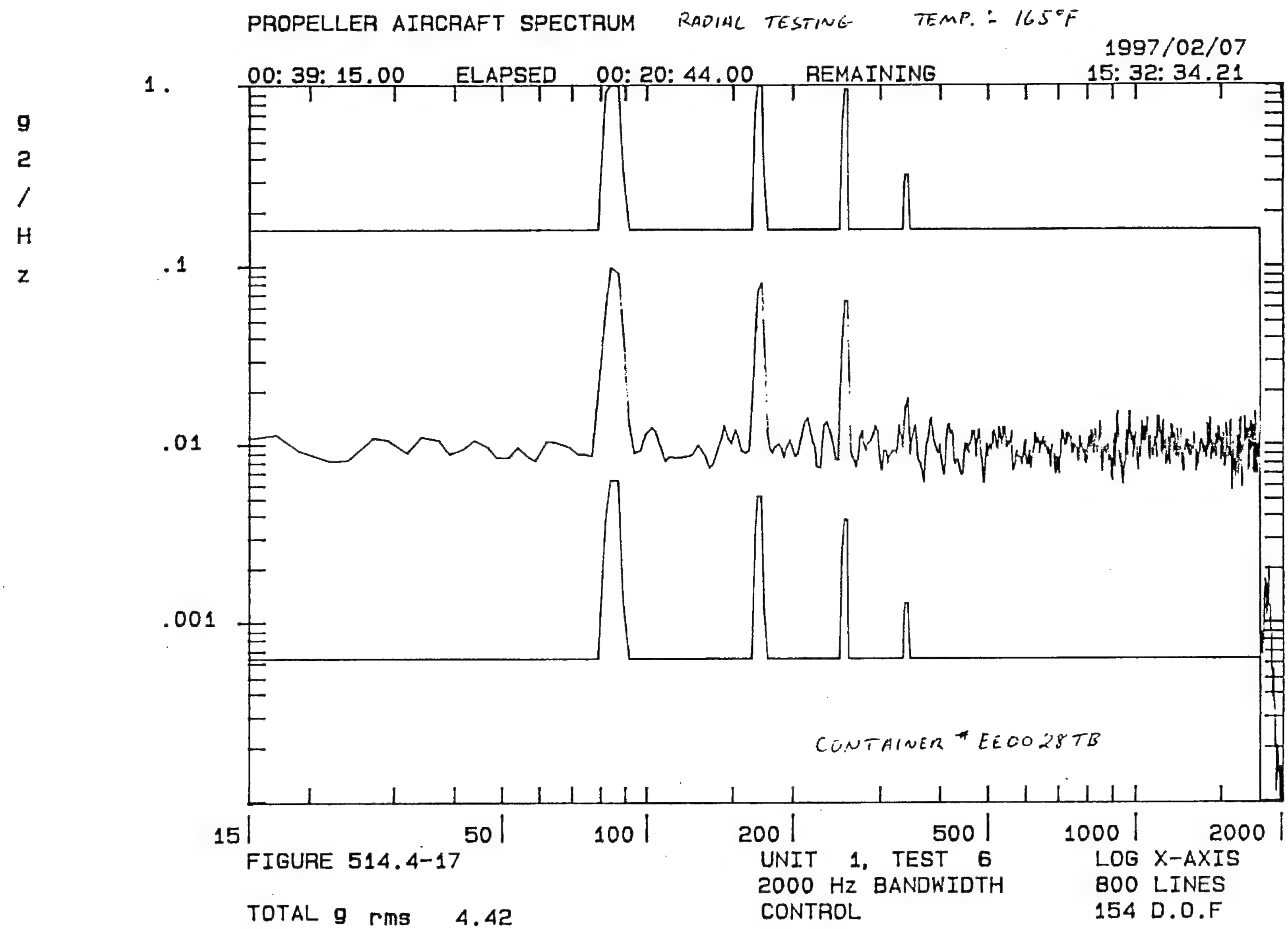
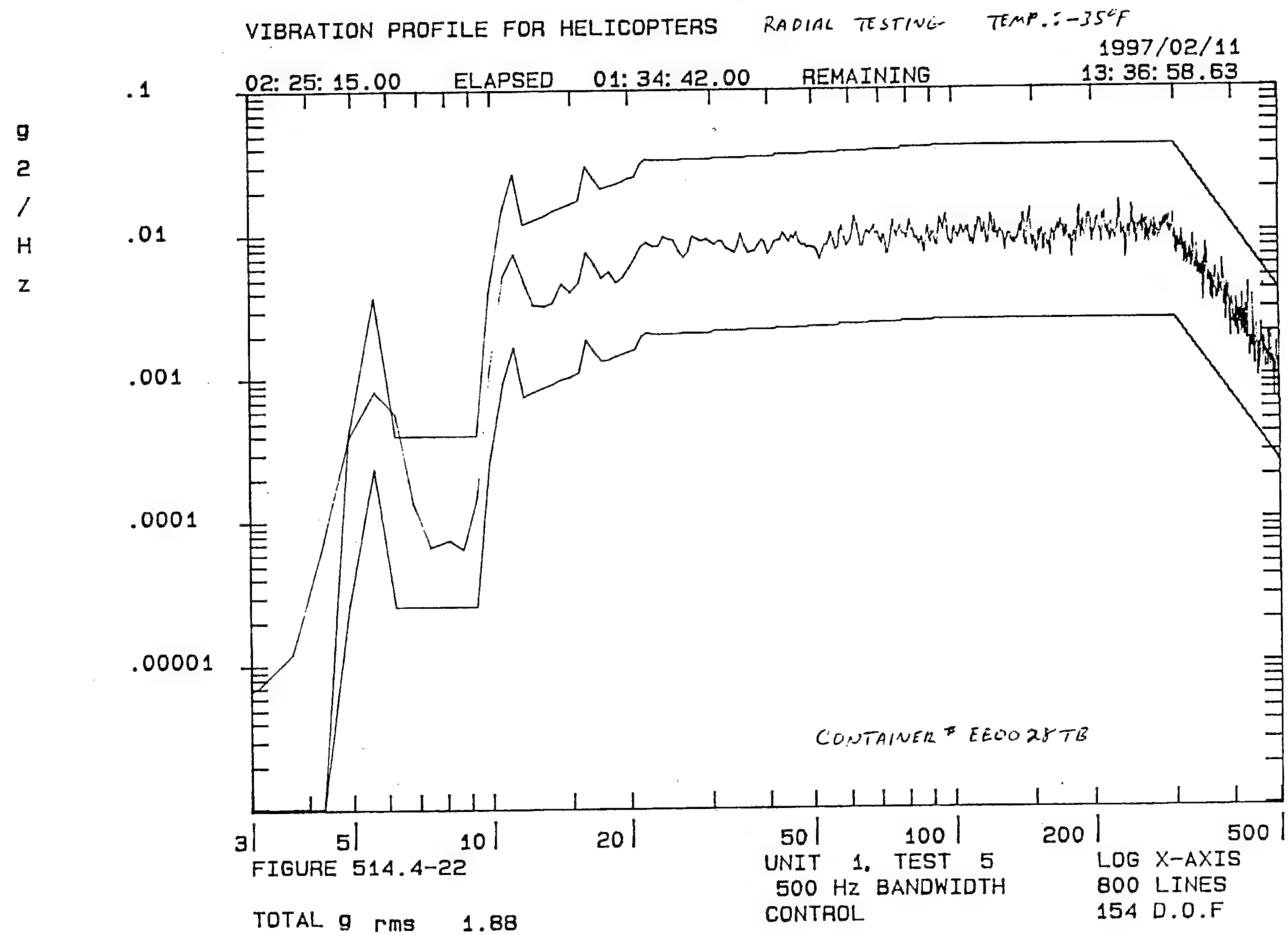


FIGURE 514.4-17

TOTAL g rms 4.42


VIBRATION PROFILE FOR HELICOPTERS
RADIAL TESTING
TEMP.: -35°F
1997/02/11
13: 36: 58.63
02: 25: 15.00 ELAPSED
01: 34: 42.00 REMAINING
g2/Hz
.1
.01
.001
.0001
.00001
3
5
10
20
50
100
200
500
CONTAINER # EE0028TB
FIGURE 514.4-22
TOTAL g rms 1.88
UNIT 1, TEST 5
500 Hz BANDWIDTH
CONTROL
LOG X-AXIS
800 LINES
154 D.O.F

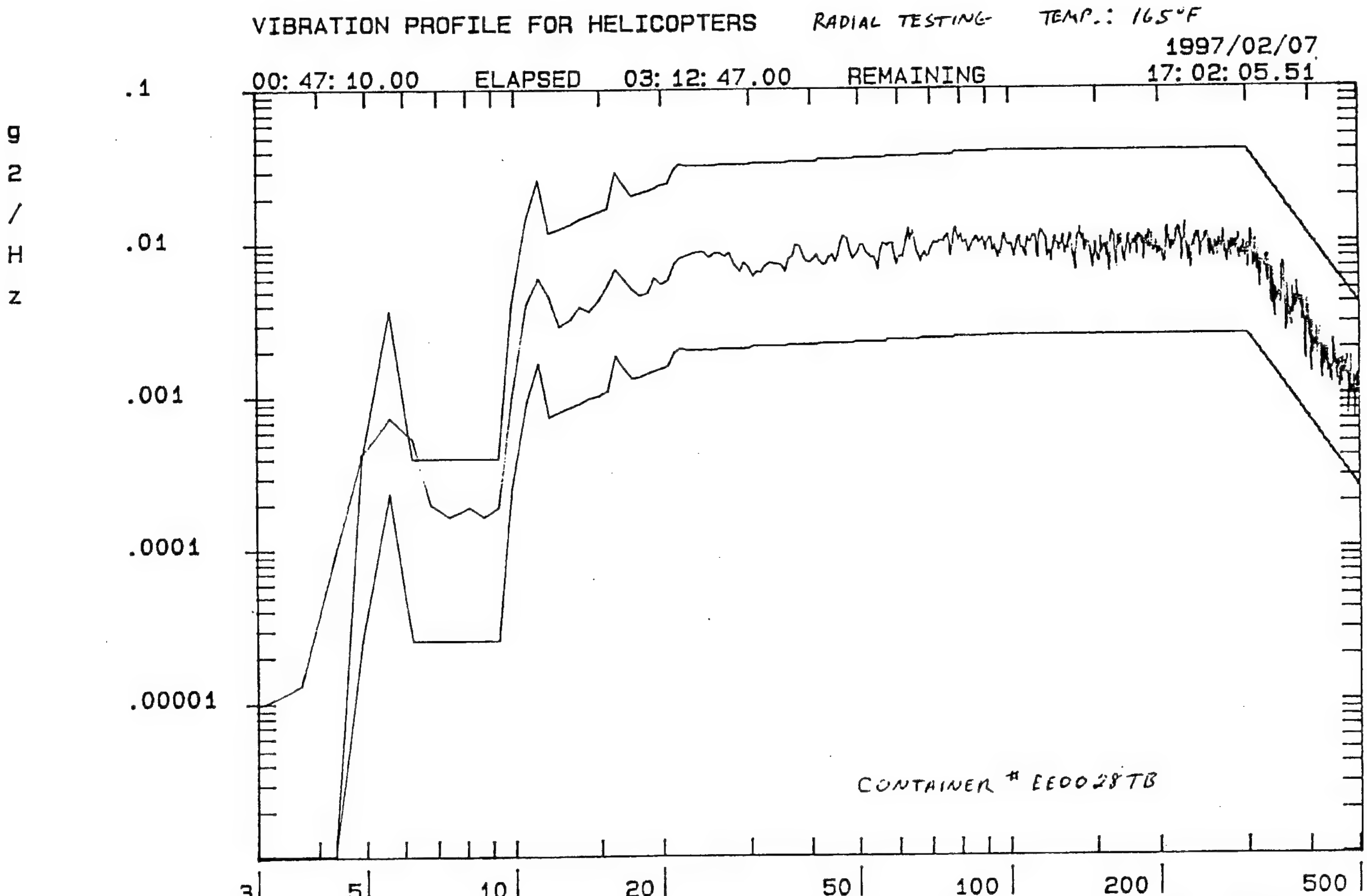
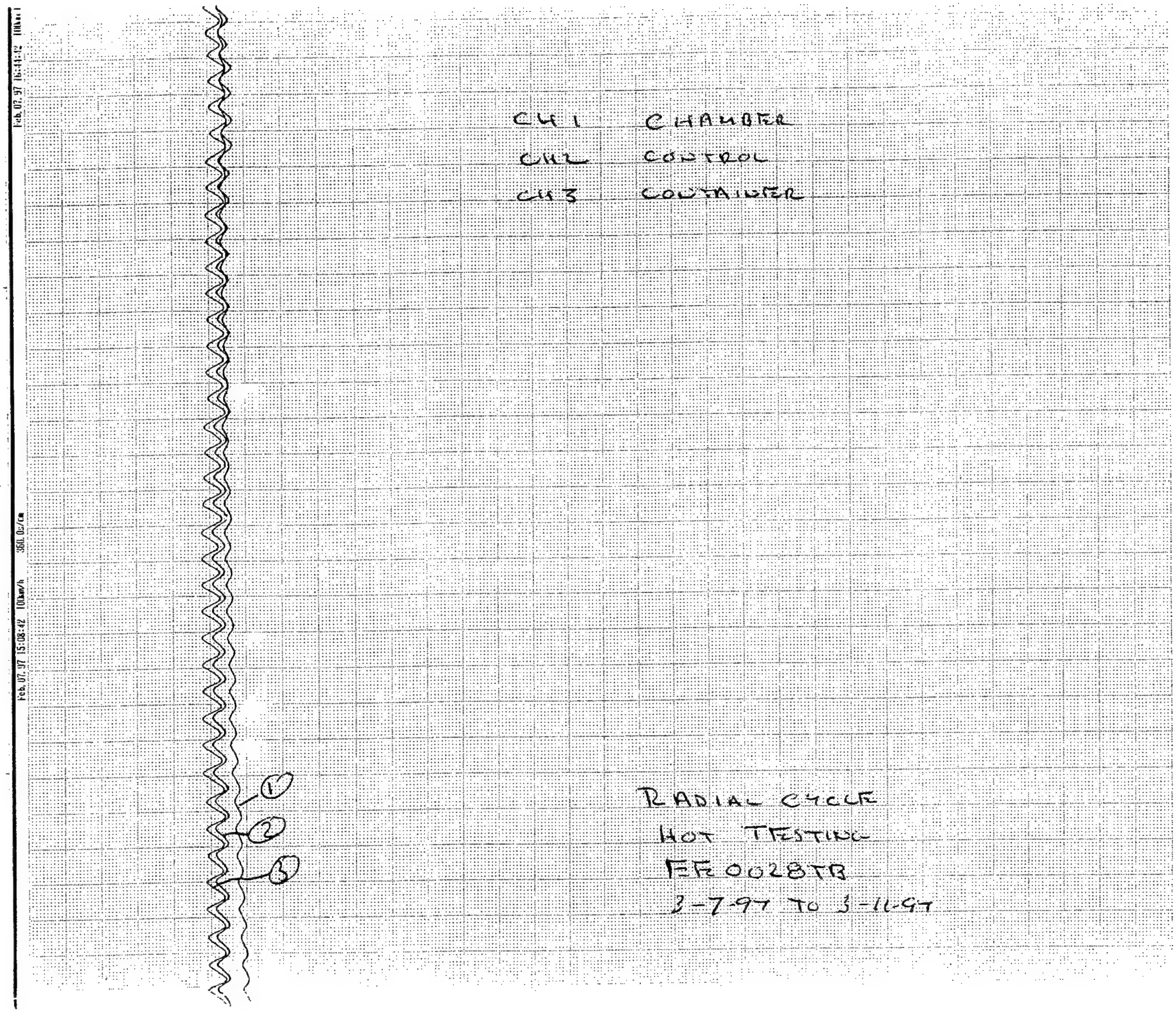
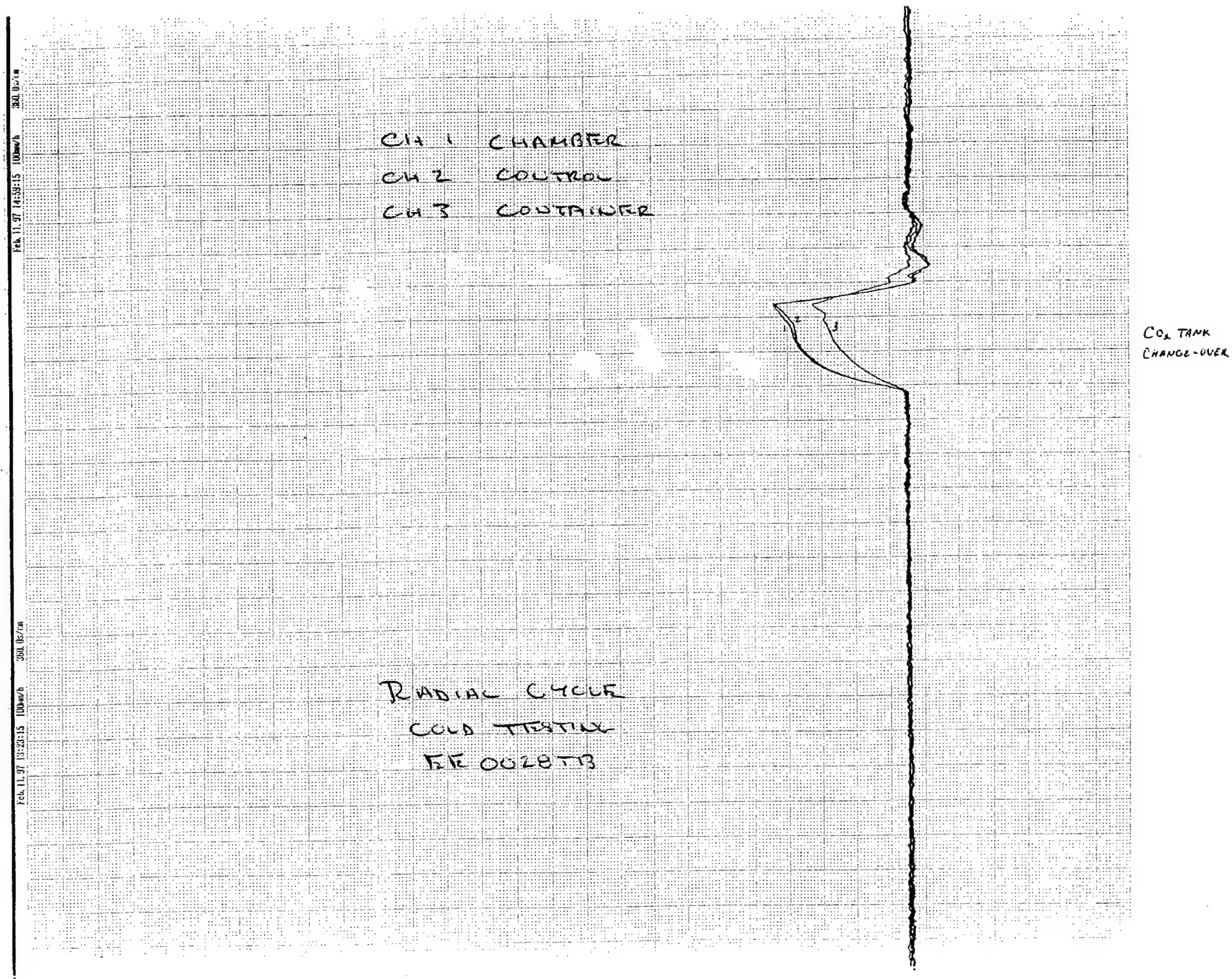


FIGURE 514.4-22

TOTAL g rms 1.84


Feb.07.97 16:41:42
Feb.07.97 15:08:42 100mm/h 360.0s/cm
CH1 CHAMBER
CH2 CONTROL
CH3 CONTAINER
1
2
3
RADIAL CYCLE
HOT TESTING
FR0028TB
3-7-97 TO 3-11-97


Feb 11 97 14:59:15 100mm/h 360.0s/cm
Feb 11 97 13:23:15 100mm/h 360.0s/cm
CH 1 CHAMBER
CH 2 CONTROL
CH 3 CONTAINER
RADIAL CYCLE
COLD TESTING
EE 0028TB
CO_2 TANK
CHANGE-OVER
1
2
3

032

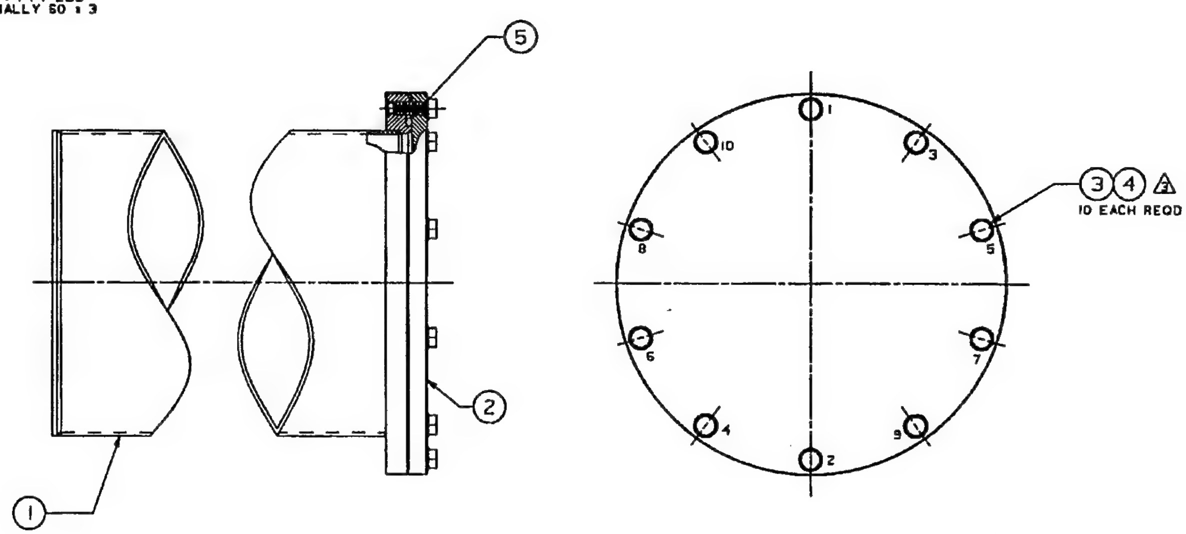
PART 12

DRAWINGS

NOTES:

1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - ☐ REMOVE BURRS ☐ BREAK SHARP EDGES .010 MAX
   - ☐ FILLETS R .010 MAX.
   - ☐ 125 ALL OVER, EXCEPT AS NOTED
   - ☐ DIMENSIONS APPLY AFTER PLATING
   - ☐ TOLERANCES ON STOCK MATERIAL SIZES SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - ☐ FED-STD-H28 APPLIES

3. WHEN CONTAINER IS EMPTY TORQUE ITEM 4 TO 2 ± .20 FT LBS. WHEN CONTAINER IS FILLED TORQUE ITEM 4 IN NUMBERED SEQUENCE SHOWN. TORQUE IN 3 INCREMENTS, FIRST 20 ± 1 FT LBS FOLLOWED BY 40 ± 2 FT LBS AND FINALLY 60 ± 3 FT LBS.



QTY REQD	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.
1	C	15-12-511	O-RING		5
10		B1821AH050F150N	SCREW, CAP, HEX. HD., CAD. PL., .500-20UNF-2A X 1.50 LG	ANSI-B18.2.1	4
10		MS35333-44	WASHER, LOCK, FLAT-INTERNAL TOOTH		3
1	D	15-12-447	FLANGE CAP		2
1	D	15-12-444-10	TUBE ASSEMBLY		1

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PLACE DECIMALS ±.04 3 PLACE DECIMALS ±.010 ANGLES ±0° 30'

MATERIAL

DRAWN BY DBA

U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER ABERDEEN PROVING GROUND, MARYLAND 21010-5423

TOXIC CHEMICAL CONTAINER, -1

SIZE D | CAGE CODE 81361 | DWG NO. 15-12-442

SCALE 1/2 | SHEET

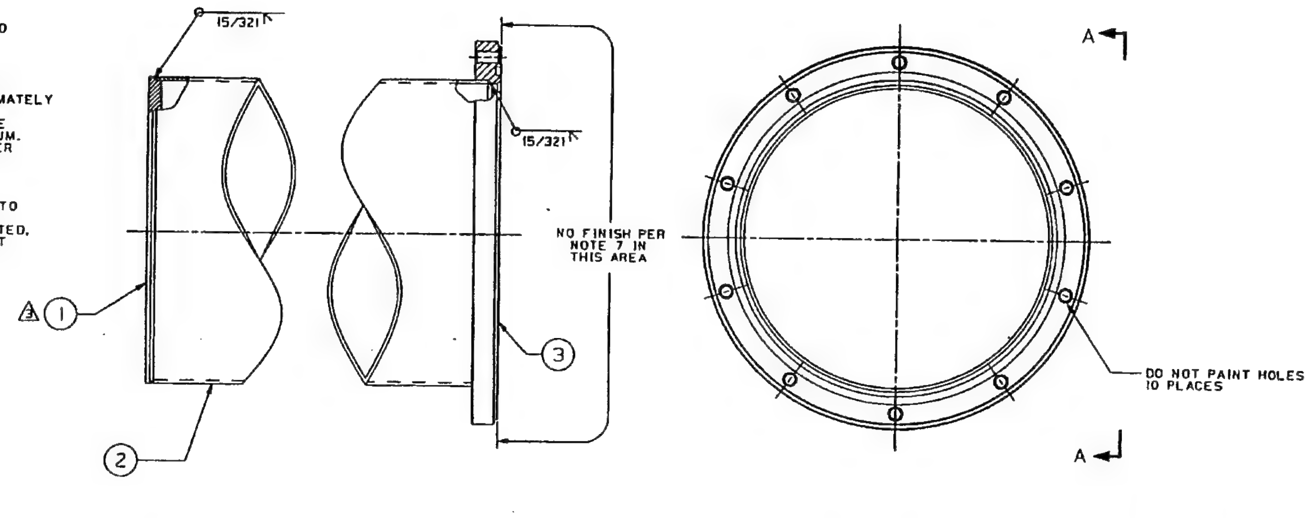
APPLICATION: END ITEM CODE NO. 122

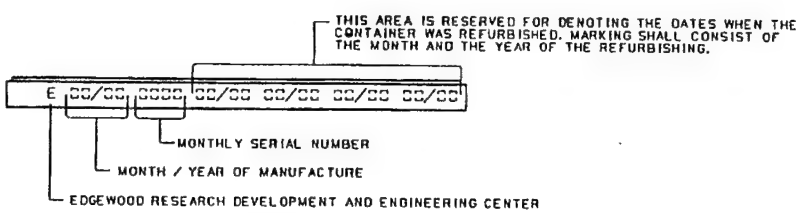
REVISIONS

NOTES:

1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - ☐ REMOVE BURRS ☐ BREAK SHARP EDGES .010 MAX
   - ☐ FILLETS R .010 MAX.
   - ☐ 125/ ALL OVER, EXCEPT AS NOTED
   - ☐ DIMENSIONS APPLY AFTER PLATING
   - ☐ TOLERANCES ON STOCK MATERIAL SIZES, SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - ☐ FED-STD-H28 APPLIES

3. PRIOR TO ASSEMBLY, CLEAN THE INSIDE SURFACES OF ITEM 1 TO ENSURE REMOVAL OF ALL RUST AND SCALE.
4. USING ITEM 4, WELD IN ACCORDANCE WITH ANSI/AWS D1.1.
5. AFTER ASSEMBLY, HELIUM LEAK TEST TO 1 X 10^{-6} OR BETTER PER METHOD A OF ASTM-E498.
6. AFTER PASSING THE HELIUM LEAK TEST AND PRIOR TO PAINTING, APPLY SERIAL NO. OF ASSEMBLY AND LOCATE APPROXIMATELY AS SHOWN. SERIALIZATION SHALL BE APPLIED BY STAMPING: HEIGHT SHALL BE .38±.06 AND DEPTH SHALL BE .06 MINIMUM. SERIAL NUMBER SHALL BE VISIBLE AFTER PAINTING PER NOTE 7.
7. AFTER APPLYING THE SERIAL NUMBER, FINISH 5.2 • 20.24 COLOR INTERIOR AIRCRAFT GRAY 36231 PER MIL-STD-171 TO AREAS SPECIFIED. PRIME ALL INTERIOR AND EXTERIOR SURFACES EXCEPT AS NOTED. PAINT EXTERIOR SURFACES ONLY EXCEPT AS NOTED.





VIEW A-A
ROTATED 90° CW
SCALE NONE
SEE NOTE 6

QTY REQD -20	QTY REQD -10	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.
A/R	A/R			CARBON STEEL ELECTRODE, CLASS E71T-1	AWS A5.20	4
1	1	D	15-12-448	FLANGE BODY		3
1		C	15-12-445-2	TUBE		2
	1	C	15-12-445-1	TUBE		2
1	1	D	15-12-446	DISC CAP		1

PARTS LIST

APPLICATION	
DWG SIZE	NEXT ASSY
D	15-12-443

END ITEM CODE NO. 122

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PLACE DECIMALS ±.04
3 PLACE DECIMALS ±.010
ANGLES ±0° 30'

MATERIAL

ORIGINAL DATE YY-MM-DD 94-03-08
DRAWN BY DBA
CHECKED
ENGINEER
DESIGN APPROVAL
DRAWING APPROVAL
CONTRACT NO.

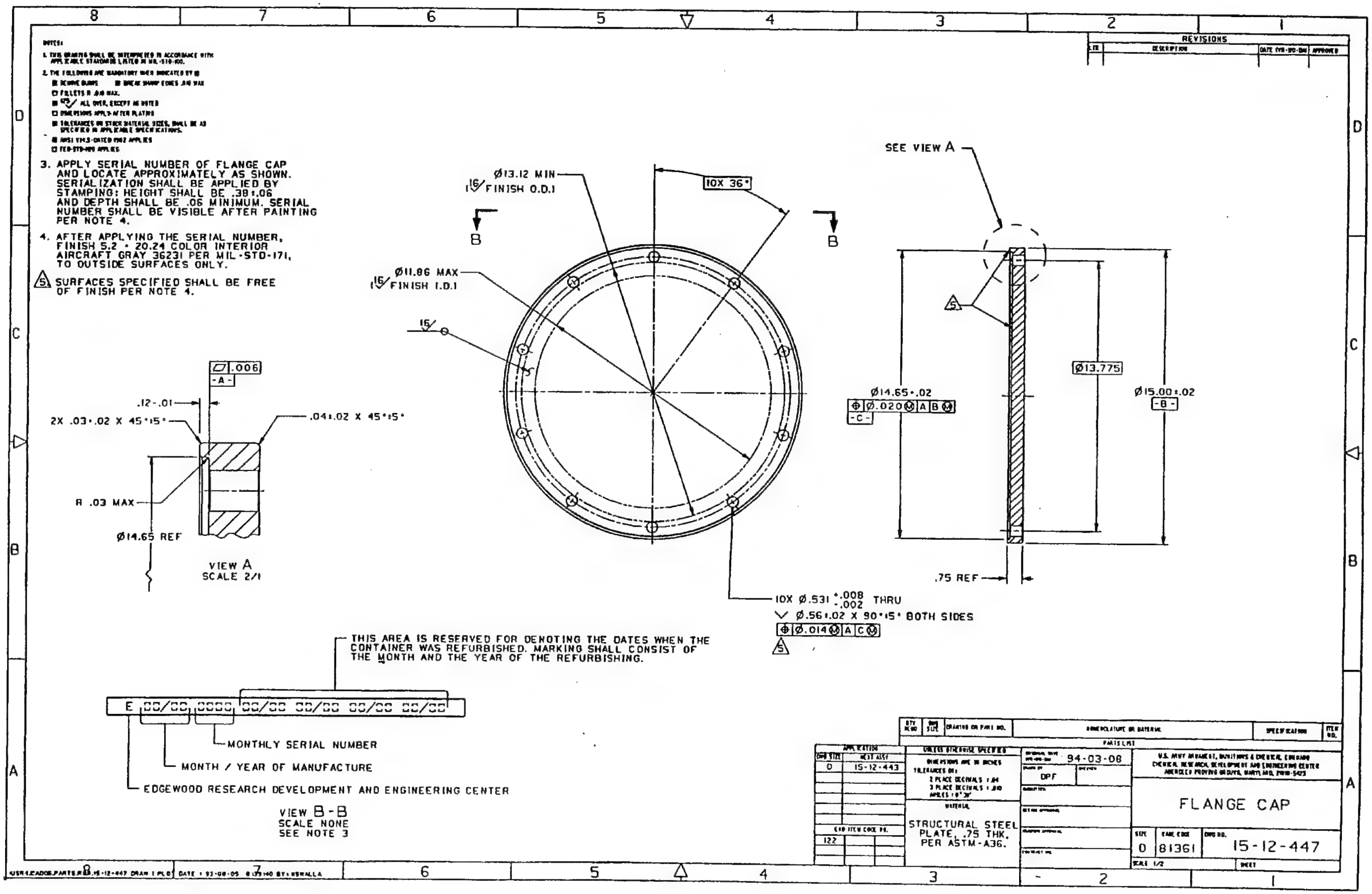
U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND, 21010-5423

TUBE ASSEMBLY

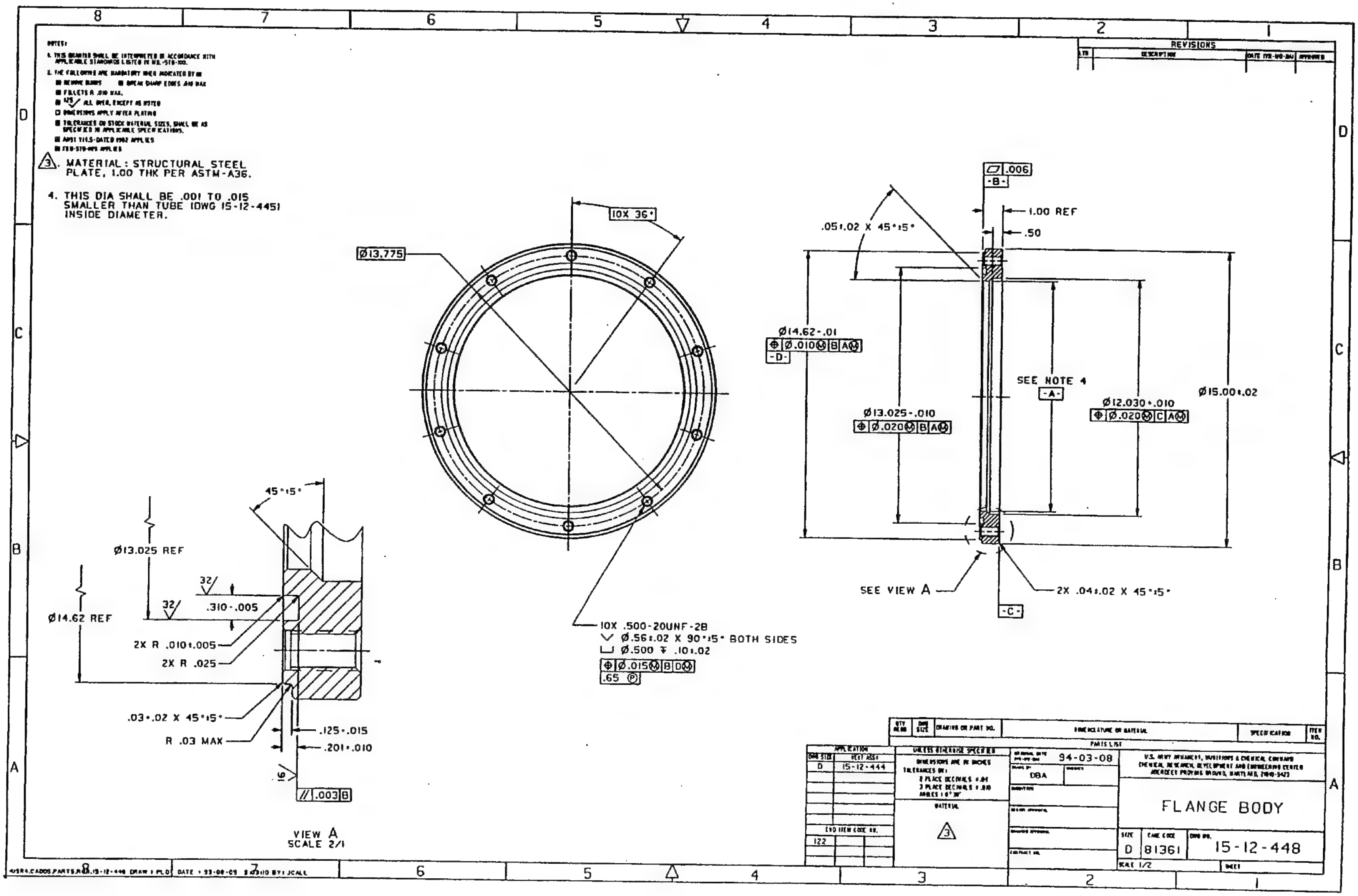
SIZE D | CAGE CODE 81361 | DWG NO. 15-12-444
SCALE 1/2 | SHEET

REVISIONS: LTR | DESCRIPTION | DATE (YY-MM-DD) | APPROVED

U/SRA,CADDS,PARTS,REL.15-12-444 DRAW 1 PLOT DATE: 94-03-08 18:46 BY: mvomr

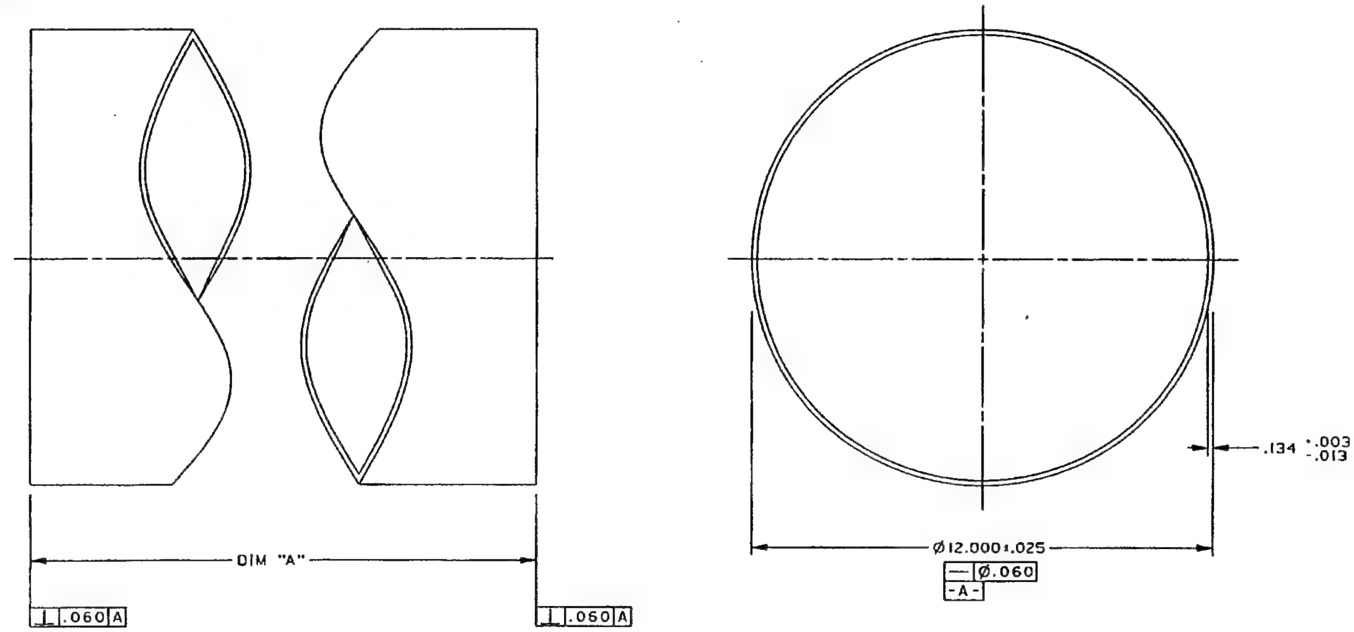


NOTES:
3. APPLY SERIAL NUMBER OF FLANGE CAP AND LOCATE APPROXIMATELY AS SHOWN. SERIALIZATION SHALL BE APPLIED BY STAMPING; HEIGHT SHALL BE .38±.06 AND DEPTH SHALL BE .06 MINIMUM. SERIAL NUMBER SHALL BE VISIBLE AFTER PAINTING PER NOTE 4.
4. AFTER APPLYING THE SERIAL NUMBER, FINISH 5.2 • 20.24 COLOR INTERIOR AIRCRAFT GRAY 36231 PER MIL-STD-171, TO OUTSIDE SURFACES ONLY.
5 SURFACES SPECIFIED SHALL BE FREE OF FINISH PER NOTE 4.
Ø13.12 MIN
FINISH O.D.
10X 36°
Ø11.86 MAX
FINISH I.D.
SEE VIEW A
Ø13.775
Ø14.65±.02
Ø.020 A B
-C-
Ø15.00±.02
-B-
.75 REF
10X Ø.531 +.008 -.002 THRU
Ø.56±.02 X 90°±5° BOTH SIDES
Ø.014 A C
.006
-A-
.12-.01
2X .03±.02 X 45°±5°
.04±.02 X 45°±5°
R .03 MAX
Ø14.65 REF
VIEW A
SCALE 2/1
THIS AREA IS RESERVED FOR DENOTING THE DATES WHEN THE CONTAINER WAS REFURBISHED. MARKING SHALL CONSIST OF THE MONTH AND THE YEAR OF THE REFURBISHING.
E □□/□□ □□□□ □□/□□ □□/□□ □□/□□ □□/□□
MONTHLY SERIAL NUMBER
MONTH / YEAR OF MANUFACTURE
EDGEWOOD RESEARCH DEVELOPMENT AND ENGINEERING CENTER
VIEW B-B
SCALE NONE
SEE NOTE 3
REVISIONS
15-12-443
94-03-08
DPF
STRUCTURAL STEEL PLATE, .75 THK, PER ASTM-A36.
U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND
FLANGE CAP
D 81361 15-12-447
SCALE 1/2


3. MATERIAL: STRUCTURAL STEEL PLATE, 1.00 THK PER ASTM-A36.
4. THIS DIA SHALL BE .001 TO .015 SMALLER THAN TUBE (DWG 15-12-445) INSIDE DIAMETER.
10X 36°
Ø13.775
10X .500-20UNF-2B
Ø.56±.02 X 90°±5° BOTH SIDES
Ø.500 ↧ .10±.02
Ø.015 B D
.65 P
.006
-B-
1.00 REF
.50
.05±.02 X 45°±5°
Ø14.62-.01
Ø.010 B A
-D-
SEE NOTE 4
-A-
Ø13.025-.010
Ø.020 B A
Ø12.030+.010
Ø.020 C A
Ø15.00±.02
SEE VIEW A
2X .04±.02 X 45°±5°
-C-
45°±5°
Ø13.025 REF
Ø14.62 REF
.310-.005
2X R .010±.005
2X R .025
.03±.02 X 45°±5°
R .03 MAX
.125±.015
.201±.010
.003 B
VIEW A
SCALE 2/1
REVISIONS
94-03-08
DBA
D 15-12-444
122
FLANGE BODY
D 81361 15-12-448
SCALE 1/2

NOTES:

1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - ■ REMOVE BURRS ■ BREAK SHARP EDGES .010 MAX
   - □ FILLETS R .010 MAX
   - □ 125 ALL OVER, EXCEPT AS NOTED
   - □ DIMENSIONS APPLY AFTER PLATING
   - □ TOLERANCES ON STOCK MATERIAL SIZES, SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - □ FED-STD-H28 APPLIES
3. PART SHALL MEET REQUIREMENTS OF ASTM-A139.



DASH NO.	DIM "A"
-1	37.00±.12
-2	51.00±.12

REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

QTY REQD	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.

PARTS LIST

APPLICATION	
DWG SIZE	NEXT ASSY
D	15-12-444
END ITEM CODE NO.	
122	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PLACE DECIMALS ±.04
3 PLACE DECIMALS ±.010
ANGLES ±0° 30'

MATERIAL
STEEL, CARBON, HOT ROLLED SHEET, OILED, PER ASTM-A569

ORIGINAL DATE (YR-MO-DA): 94-03-08
DRAWN BY: DBA
CHECKER:
SUBMITTED:
DESIGN APPROVAL:
DRAWING APPROVAL:
CONTRACT NO.:

U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND, 21010-5423

TUBE

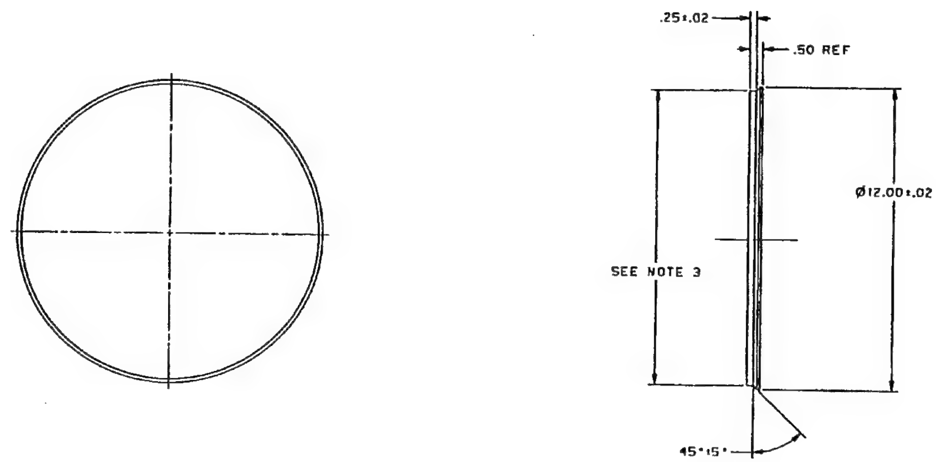
SIZE	CAGE CODE	DWG NO.
C	81361	15-12-445

SCALE 1/2 SHEET

:USR4.CADDS.PARTS.RON.15-12-445 DRAW 1 PLOT DATE : 93-07-29 15:37:33 BY: JCALL

NOTES:

1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - ■ REMOVE BURRS ■ BREAK SHARP EDGES .010 MAX
   - ■ FILLETS R .010 MAX.
   - ■ 125√ ALL OVER, EXCEPT AS NOTED
   - □ DIMENSIONS APPLY AFTER PLATING
   - ■ TOLERANCES ON STOCK MATERIAL SIZES, SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - □ FED-STD-H28 APPLIES
3. THIS DIA SHALL BE .005 TO .020 SMALLER THAN TUBE (DWG 15-12-445) INSIDE DIAMETER.



QTY REQD	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.

PARTS LIST

APPLICATION	
DWG SIZE	NEXT ASSY
D	15-12-444
END ITEM CODE NO.	
122	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PLACE DECIMALS ±.04
3 PLACE DECIMALS ±.010
ANGLES ±0°30'

MATERIAL: STRUCTURAL STEEL PLATE, .500 THK, PER ASTM-A36.

ORIGINAL DATE: 94-03-08
DRAWN BY: JLH
CHECKED:
ENGINEER:
DESIGN APPROVAL:
DRAWING APPROVAL:
CONTRACT NO.

U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND 21010-5423

DISC CAP

SIZE	CAGE CODE	DWG NO.
D	81361	15-12-446

SCALE 1/2 SHEET

NOTES:

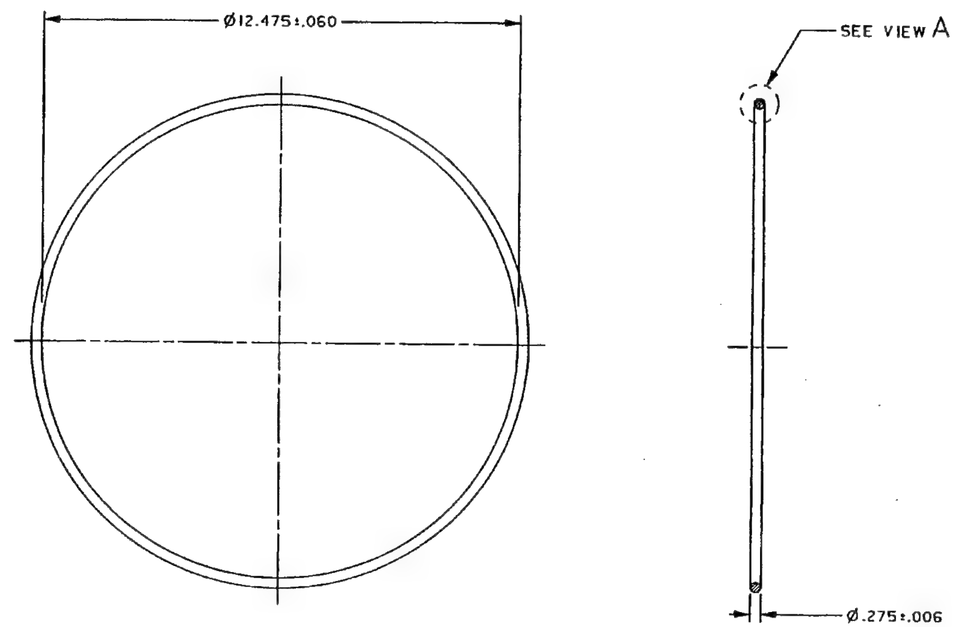
1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - □ REMOVE BURRS □ BREAK SHARP EDGES .010 MAX
   - □ FILLETS R .010 MAX
   - □ 125/ ALL OVER, EXCEPT AS NOTED
   - □ DIMENSIONS APPLY AFTER PLATING
   - □ TOLERANCES ON STOCK MATERIAL SIZES, SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - □ FED-STD-H28 APPLIES
3. IDENTIFICATION OF THE SUGGESTED ITEMS HEREON IS NOT TO BE CONSTRUED AS A GUARANTEE OF PRESENT OR CONTINUED AVAILABILITY.
4. MATERIAL : BUTYL RUBBER, PHOSPHATE ESTER RESISTANT, 70±5 DUROMETER, PER AMS-3238.

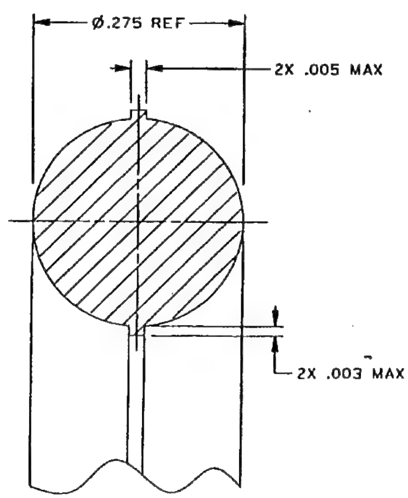
SUGGESTED SOURCES OF SUPPLY

CONTROL NUMBER	SUPPLIER DATA		
	CAGE CODE	PART NUMBER	NAME AND ADDRESS
15-12-511	02697	2-454 B318-70	PARKER SEAL GROUP O-RING DIVISION 2360 PALUMBO DRIVE LEXINGTON, KY 40512

REVISIONS

LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED





VIEW A
SCALE NONE

VENDOR ITEM DRAWING

QTY REQD	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.

PARTS LIST

APPLICATION	
DWG SIZE	NEXT ASSY
D	15-12-443
END ITEM CODE NO.	
122	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
2 PLACE DECIMALS ±.04
3 PLACE DECIMALS ±.010
ANGLES ± 0° 30'

MATERIAL
SEE NOTE 4

ORIGINAL DATE (YR-MO-DA): 94-03-08
DRAWN BY: DBA
CHECKER
SUBMITTED
DESIGN APPROVAL
DRAWING APPROVAL
CONTRACT NO.

U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ABERDEEN PROVING GROUND, MARYLAND, 21010-5423

O-RING

SIZE	CAGE CODE	DWG NO.
C	81361	15-12-511
SCALE 1/2		SHEET

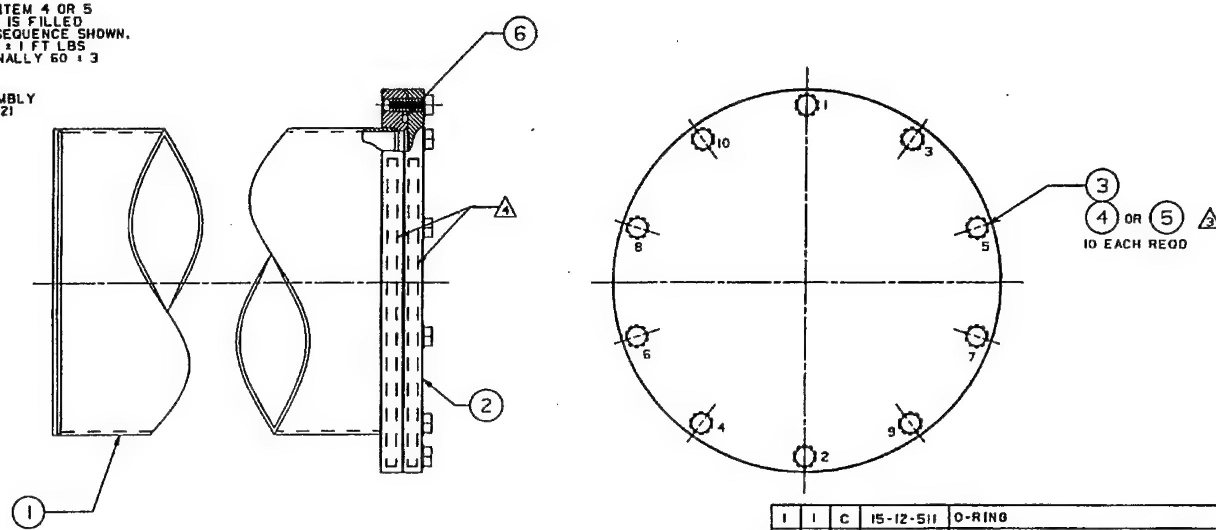
:USR4.CADDS.PARTS.RON.15-12-511 DRAW 1 PLOT DATE = 93-07-30 14:48:39 BY: JCALL

NOTES:

1. THIS DRAWING SHALL BE INTERPRETED IN ACCORDANCE WITH APPLICABLE STANDARDS LISTED IN MIL-STD-100.
2. THE FOLLOWING ARE MANDATORY WHEN INDICATED BY ■
   - □ REMOVE BURRS □ BREAK SHARP EDGES .010 MAX
   - □ FILLETS R .010 MAX.
   - □ 125 ✓ ALL OVER, EXCEPT AS NOTED
   - □ DIMENSIONS APPLY AFTER PLATING
   - ■ TOLERANCES ON STOCK MATERIAL SIZES, SHALL BE AS SPECIFIED IN APPLICABLE SPECIFICATIONS.
   - ■ ANSI Y14.5-DATED 1982 APPLIES
   - □ TED-STD-920 APPLIES

3. WHEN CONTAINER IS EMPTY TORQUE ITEM 4 OR 5 TO 2 ± .20 FT LBS. WHEN CONTAINER IS FILLED TORQUE ITEM 4 OR 5 IN NUMBERED SEQUENCE SHOWN. TORQUE IN 3 INCREMENTS, FIRST 20 ± 1 FT LBS FOLLOWED BY 40 ± 2 FT LBS AND FINALLY 60 ± 3 FT LBS.

4. SERIAL NUMBERS OF THE TUBE ASSEMBLY (ITEM 1) AND THE FLANGE CAP (ITEM 2) SHALL MATCH, AND SHALL REMAIN TOGETHER AS A SET.



1	1	C	15-12-511	O-RING		6
10	10		B18218H050F150N	SCREW, CAP, HEX. HD., ZINC CTD., .500-20UNF-2A X 1.50 LG	ANSI-B18.2.1	5
10	10		B1821AH050F150N	SCREW, CAP, HEX. HD., CAD. PL., .500-20UNF-2A X 1.50 LG	ANSI-B18.2.1	4
10	10		MS35335-37	WASHER, LOCK, FLAT-EXTERNAL TOOTH		3
1	1	D	15-12-447	FLANGE CAP		2
1		D	15-12-444-20	TUBE ASSEMBLY		1
	1	D	15-12-444-10	TUBE ASSEMBLY		1
X		D	15-12-443-200	TOXIC CHEMICAL CONTAINER, -2		—
	X	D	15-12-443-100	TOXIC CHEMICAL CONTAINER, -1		—
-200 ASSY	-100 ASSY	DWG SIZE	DRAWING OR PART NO.	NOMENCLATURE OR MATERIAL	SPECIFICATION	ITEM NO.
QTY	QTY			PARTS LIST		

REVISIONS

LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

APPLICATION: DWG SIZE / NEXT ASSY

END ITEM CODE NO. 122

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: 2 PLACE DECIMALS ±.01 3 PLACE DECIMALS ±.010 ANGLES ±0°30'

MATERIAL

ORIGINAL DATE 94-03-08

DRAWN BY DBA

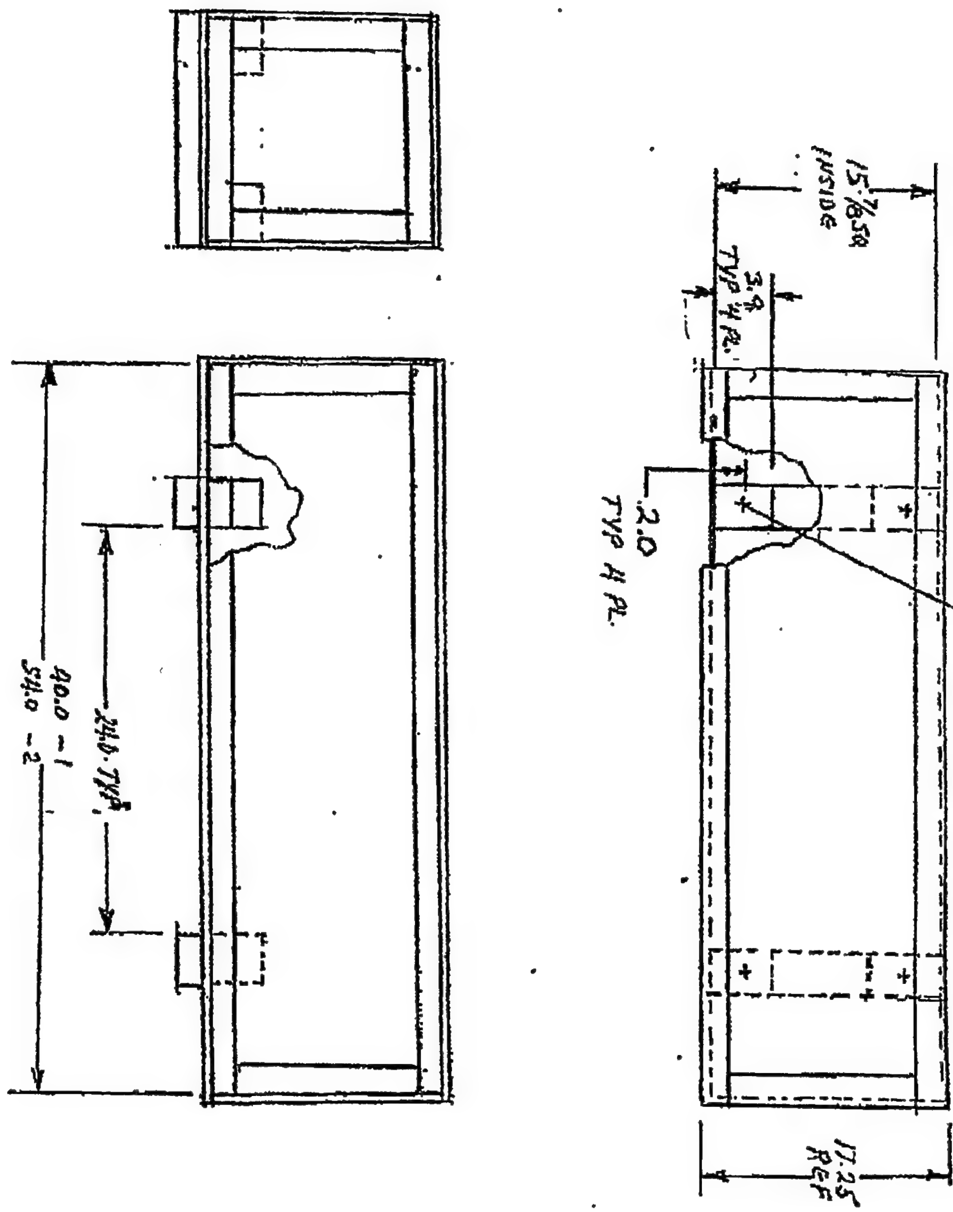
U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND CHEMICAL RESEARCH, DEVELOPMENT AND ENGINEERING CENTER ABERDEEN PROVING GROUND, MARYLAND, 21010-5423

TOXIC CHEMICAL CONTAINER

SIZE D CAGE CODE 81361 DWG NO. 15-12-443

SCALE 1/2 SHEET

U184.CADDS.PARTS.R.15-12-443 DRAW 1 PLOT DATE: 94-03-08 15:47:14 BY: LMMAY


15 7/8 SQ
INSIDE
3.9
TYP 4 PL.
.2.0
TYP 4 PL.
.75 DIA
TYP 4 PL
17.25
REF
24.0 TYP.
40.0 -1
54.0 -2

SRC SHIPPING CONTAINERS

SIZE:

-1 15 7/8" X 15 7/8" X 40.0" INSIDE

-2 15 7/8" X 15 7/8" X 54.0" INSIDE

CONSTRUCTION:

INSIDE SKIN TO BE 1/4" PLYWOOD MIN

OUTSIDE FRAME TO BE STD 1" X 2"

INSIDE SUPPORT TO BE STD 2" X 4"

FORK LIFT RAILS OUTSIDE TO BE STD 2" X 4"

ENDS TO BE 16.0" X 16.0" NAILED OR STAPLED INTERNAL TO THE OUTSIDE SKIN

FORK LIFT RAILS TO BE 24.0 INCHES APART CENTERED ON BOTH BOXES

TIE DOWN HOLES TO BE DRILLED THRU INSIDE SUPPORTS AND FORK LIFT RAILS

PART 13

APPENDIX

DETSI Project Number: U10-8762
February 1997

USADACS HAZARDOUS MATERIAL CONTAINER TESTING CHECKLIST

TANK EE0028TB

*** Mark all PLOTS, PHOTOGRAPHS, and PAPERWORK with the number stamped on the flange of each container.**

Item		DONE (√)		NAME
I) Vibration Testing Horizontal (perpendicular to axis)	I)			
A) Helicopter Spectrum	A)			
1) +165°F Vibration Plot	1)	✓	2/7	TK
2) +165°F Temperature Plot	2)	✓	2/7	TK
3) -35°F Vibration Plot	3)	✓	2/11	TK
4) -35°F Temperature Plot	4)	✓	2/11	TK
5) Test Set Up Photographs	5)	✓	2/19	TK
6) Video Segment	6)			
B) Aircraft Spectrum	B)			
1) +165°F Vibration Plot	1)	✓	2/7	TK
2) +165°F Temperature Plot	2)	✓	2/7	TK
3) -35°F Vibration Plot	3)	✓	2/11	TK
4) -35°F Temperature Plot	4)	✓	2/11	TK
5) Test Set Up Photographs	5)	✓	2/19	TK
II) Vibration Testing Horizontal Axially	II)			
A) Helicopter Spectrum	A)			
1) +165°F Vibration Plot	1)	✓	2/5	TK
2) +165°F Temperature Plot	2)	✓	2/5	TK
3) -35°F Vibration Plot	3)	✓	2/6	TK
4) -35°F Temperature Plot	4)	✓	2/6	TK
5) Test Set Up Photographs	5)	✓	2/19	TK
6) Video Segment	6)			
B) Aircraft Spectrum	B)			
1) +165°F Vibration Plot	1)	✓	2/5	TK
2) +165°F Temperature Plot	2)	✓	2/5	TK
3) -35°F Vibration Plot	3)	✓	2/6	TK
4) -35°F Temperature Plot	4)	✓	2/6	TK
5) Test Set Up Photographs	5)	✓	2/19	TK
III) Additional Requirements for the Final Report	III)			
1) A copy of the test specification	1)			
2) Lockhed Certification paperwork	2)			
3) Calibration information and paperwork	3)			
4) Test Introduction	4)			
5) Test Procedure	5)			
6) Test Conclusions	6)			
7) Photographs of the test set up	7)	✓	2/19	TK
8) Equipment List	8)			

1/20/1996 15:27

SURVEY SUMMARY SHEET - Page 1

SURVEY NO : 960680
SURVEYOR : MAZZOLA

UPPLIER : DATA SYSTEMS ENGINEERING & TEST
ADDRESS : S. 14TH. W. 33511 HWY 18
DELAFIELD WI 53018
414
HONE : ~~(414)~~ 968-4003
CONTACT : QUALITY MANAGER
CORP CODE : 960680
/P CODE : D102201
CCOUNT : 203017

QA CODE	SPECIFICATION	TITLE	SURVEYOR: APPROVED	SURVEYOR: DISAPPROVED	SURVEYOR: APPROVED WITH C/A	SURVEYOR: WITHHELD PENDING C/A	SURVEYOR: SURVEY TERMINATED	SURVEYOR: CANCELLED	EVALUATOR: APPROVED	EVALUATOR: DISAPPROVED	EVALUATOR: APPROVED WITH C/A	EVALUATOR: WITHHELD PENDING C/A	EVALUATOR: SURVEY TERMINATED	EVALUATOR: CANCELLED
4B	MIL-I-45208A	INSPECTION SYSTEM REQMTS	X											
4K	MIL-STD-45662	CALIBRATION SYSTEM REQMTS	X											
04R		NONDELIVERABLE SOFTWARE REQMTS						X						
4N		LMA SPECIAL PROCESSORS ONLY	X											

UPPLIER MGMT : David Hamilton Sr. DATE : 12/03/96

SURVEYOR : D Mazzola DATE : 12/03/96

VALUATOR : ______ DATE : ______

LOCKHEED MARTIN

QUALITY CONTROL SYSTEM SURVEY REPORT

PROCESSOR: DATA SYSTEMS ENGINEERING	AREA CODE: 414	PHONE NO: 968-4003	SURVEY NO 960680
STREET: S. 14TH W. 33511 HWY 18	CITY: DELAFIELD	STATE: WI	ZIP CODE 53018
DATE OF SURVEY: 12/03/96 / PERFORMED BY: A. MAZZOLA / DIVISION: DENVER	REQUESTED BY: D. VANCIL	DIVISION: DENVER	☒ PRE-AWARD ☐ RESURVEY

KEY SUPPLIER PERSONNEL

NAME: DAVID E. HOISINGTON SR.	TITLE: VICE PRESIDENT / SEC[illegible]
NAME: THOMAS Q KINZEL	TITLE: MANAGER, ELECTRONIC S[illegible]
NAME: ANDREW A. HOISINGTON	TITLE: MANAGER, TESTING S[illegible]
NAME:	TITLE:
TOTAL NUMBER OF EMPLOYEES: 6	QUALITY CONTROL PERSONNEL: 2

PRIMARY PRODUCT LINE: INDEPENDANT, THIRD PARTY PRODUCT TESTING AND PRODUCT DEVELOPMENT. (VIBRATION, ENVIRONMENTAL & STRESS [illegible])

GOVERNMENT INSPECTION SERVICE/AGENCY: N/A ☐ RESIDENT ☐ ITINERANT

QUALITY CONTROL SYSTEM REQUIREMENTS DOCUMENT SURVEYED TO: MIL-I-45208A MIL-STD-45662A

COMMENTS:

SEE RECOMMENDATIONS ABOVE.
☒ APPROVED ☐ DISAPPROVED

[signature] Sr.	12/03/96	[signature]	12/03/96
SUPPLIER REPRESENTATIVE (ACKNOWLEDGMENT OF DEBRIEFING)	DATE	LOCKHEED MARTIN SURVEYOR	DATE
		LOCKHEED MARTIN EVALUATOR	DATE

FORM: MMQ008

DATASYST

ENGINEERING & TESTING SERVICES, INC.

TEST TITLE HAZARDOUS MATERIAL CONTAINER TEST

CUSTOMER USADACS PROJECT NO. U10-8762 DATE 2/5/97

SPECIMAN HAZARDOUS MATERIAL CONTAINER LAB ______

PART NO. ______ SERIAL NO. ______ ENG'RG ______

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	INSTR. NO.	CALIBRATION		ACCY.
					LAST	DUE	
SHAKER SYSTEM	LING	PP 20/35		24			
SLIP TABLE	TEAM	482.36		201			
CONTROLLER	S-D	SD400A		1022	PRIOR TO TEST		
TEMPERATURE RECORDER	YOKOGAWA	OR2300		22WL0081			
THERMOCOUPLE CALIBRATOR	OMEGA	CL23A		T-102844	11/29/96	11/29/97	
ACCELEROMETER	PCB	308B		2365			
ACCELEROMETER STANDARD	ENDEVCO	2270		SA86	11/27/96	11/27/97	
MULTIMETER	FLUKE	8060A		3910073	11/29/96	11/29/97	
CONTROLLER STANDARD	DPC	DP 540			9/26/96	9/26/97	

Where applicable, the listed test equipment has been calibrated using standards which are traceable to the National Bureau of Standards. Certificates and reports of all calibrations are retained in the **DATASYST** ENGINEERING & TESTING SERVICES INC. files and are available for inspection upon request.

TEST EQUIPMENT CALIBRATION SYSTEM
[Format Established with MIL-STD - 45662, 10 June 1980]

5.1 Calibration System Description

The following parametric transducer systems are provided with traceable reference standards for calibration.

- Acceleration
- Temperature
- Resistance
- Voltage / Current
- Pressure
- Load
- Displacement
- Frequency

Reference and transfer standards are provided as follows:

- Reference (back to back) Accelerometer System
- Portable Voltage & Frequency Signal Simulator
- Portable Thermocouple Calibrator and Readout
- Portable Digital Multimeter for Voltages (AC / DC), Currents (AC / DC) and Resistance
- Transfer Standard Resistors
- Dead Weight Pressure Tester
- Micrometer Displacement Tester
- Dead Weight / Force Load Provisions

The following external calibration services are utilized to provide traceability to in-house standards and calibration procedures -

- American Metrology ; Kenosha, WI
- West Caldwell Calibration Laboratories; West Caldwell, NJ
- Precision Metrology; Milwaukee, WI
- Data Physics Corporation; San Jose, CA
- Technimet Corporation; New Berlin, WI
- Accurate Gage, Inc.; West Allis, WI

Also instrument manufactures are utilized to repair and recalibrate devices in specific situations as required.

5.2 Adequacy of Standards

The standards have sufficient resolution and accuracy to meet the provisions in specification requirements.

5.3 Environmental Controls

The measurement standards are stored and utilized in a suitable environment to maintain required accuracy. Measuring and test equipment are utilized within the limits of design criteria for each device.

5.4 Intervals of Calibration

The intervals of calibration are determined on the basis of the following:

- ❒ Noted stability of the device
- ❒ After any repair or modification
- ❒ Degree of usage
- ❒ For particular close tolerance accuracy requirements in critical projects.

Additional recall notifications are also provided by external calibration services for standards.

5.5 Calibration Procedures

Measurement standards are to be retained in the calibration standards office / laboratory, unless temporary usage at test site location is required or in transit to external calibration service facilities.

Measurement and test equipment systems shall have parametric effects established as required by usage along with basic single or dual point sensitivities for the individual devices or as system performance criteria.

5.5 Calibration Procedures (continued)

Manufacturers reference guides may be used where applicable.

Back to back comparisons are preferable where possible, and overall system performance and sensitivities established within the expectations of the static and dynamic requirements for the data acquisition.

5.6 Out of Tolerance Evaluations

If devices are found to have been used outside of design limits a calibration check is warranted with appropriate action taken to tag out of specification devices with recommendation for repair, recalibration or replacement.

The project expectation proposal shall be used as a basis to evaluate or correlate the measurement or data acquisition for reliability.

Critical testing may include before and after test calibration check on system performance to verify data accuracy.

Utilization of in-house forms is recommended for pre-test checks and documentation of actual testing measuring devices and calibration systems used in test programs.

SBPO2-AO15-0084

U.S. Army Small Burials Program

Weldment Inspection Report

For

Single Round Container

Serial Numbers:
DD0010TB, DD0031TB, DD0049TB,
EE0001TB, EE0014TB, and EE0028TB

Contract DAAA09-95-D-0001

CDRL A015, Task 0002

Prepared For:

Department of the Army
Project Manager for Non-Stockpile Chemical Materiel
Aberdeen Proving Ground, MD 21010-5401

October 8, 1996

Prepared by:

U.S. Army Small Burials Program
Teledyne Brown Engineering
Huntsville, AL 35807

SBPO2-AO15-0084
8 October 1996

Abstract

This Weldment Inspection Report documents the 100% X-Ray inspection of the seam welds for the following six (6) Single Round Containers (SRCs) being shipped to the U.S. Army Defense Ammunition Center and School for performance-oriented packaging testing. The welds were 100% X-Ray inspected as directed by Contract DAAA09-95-D-0001, Task Order 0002, paragraph 3.3.3. This report contains a copy of the SRC Shipment transmittal letter which includes verification that the X-Rays were accomplished per the task order, and copies of the X-Ray report for each of the six SRCs, as well as the results of welding inspections repeated on two of the six SRCs that were reworked following failure of the initial inspections. This report was prepared and is submitted in compliance with the referenced task order, paragraph 7.1, and Contract Data Requirements List (CDRL) Data Item A015.

Prepared By: Date:

10/9/96
Lloyd F. Silva
Program Assurance Manager

Approved By: Date:

10/9/96
W.A. Meyer, PE
Director of Safety and Product Assurance

Approved By: Date:

for William A. Danne 9Oct96
David R. Childers
Manager, Task 0002

Approved By: Date:

William A. Danne 9Oct96
William A. Danne, PE
Chief Engineer, Small Burials Program

Approved By: Date: 10/9/96

Larry S Maupin
Larry S. Maupin
Program Manager, Small Burials Program

TELEDYNE BROWN ENGINEERING
CUMMINGS RESEARCH PARK
300 SPARKMAN DRIVE
P.O. BOX 070007
HUNTSVILLE, AL 35807-7007
(205) 726-1000 FAX (205) 726-1033

SBPO 96-244

October 8, 1996

VHS-0581-96
Mail Stop #25

U.S. Army Defense Ammunition Center and School
ATTN: SIOAC-DEV/Mr. William Meyer
Savanna, IL 61074-9639

Subject: Contract DAAA09-95-D-0001/0002; Shipment of Single Round Containers

Dear Mr. Meyer:

Provided herewith are three (3) "X", and three (3) "XX" Single Round Containers (SRCs) which have been manufactured and initially tested by Teledyne Brown Engineering per the above contract, task order number 0002. These SRCs are being provided for performance oriented packaging testing as directed by Mod 1 to the aforementioned task order.

This is to further verify that the following six SRCs have successfully passed the tests indicated:

Serial Numbers: DD0010TB, DD0049TB, DD0031TB, EE0001TB, EE0014TB, and EE0028TB;

Leak Rate: Per section 3.3.1 of referenced task order; He leak rate was $\leq 1X10^{-6}$ cc He/sec at atmospheric conditions;

Seal Reliability: Per section 3.3.2 of referenced task order; Flanges and lids were 100% tested to assure that sealing surfaces meet finish requirements; O-rings were 100% inspected to certify material composition, shape, and physical integrity;

Structural Integrity: Per section 3.3.3 of referenced task order; Seam welds were 100% X-Ray inspected; as was agreed upon during task negotiations, it was not possible to X-Ray remaining (fillet) welds, therefore they were verified during the He leak testing;

Statistical Dimensional Finish Check: Per section 3.3.4 of referenced task order; A statistical check was performed to verify dimensions as delineated on the Engineering Drawings;

SRC Traceability: Per section 3.3.5 of referenced task order; Each SRC has been permanently labeled on lid and body with the serial number referenced above.

Should you have any questions of a technical nature, please contact Mr. Lloyd Silva at (205) 726-5460. All other matters should be addressed to the undersigned at (205) 726-3589 or via FAX at (205) 726-3187.

Sincerely,

TELEDYNE BROWN ENGINEERING
A Division of Teledyne Industries, Inc.

V. Hal Smith

V. Hal Smith
Senior Contract Administrator

cc: AMSIO-ACE-S/Kevan Woodin
SFAE-CD-NM/Eric Kauffman
SFAE-CD-SS/Gregory St. Pierre
AED
Lloyd Silva, TBE
Small Burials Program Office, TBE

TELEDYNE BROWN ENGINEERING RINRSN RI-1393

NONCONFORMANCE REPORT

RI Shop Mechanical

ORIGINAL TBE 42 6/20/96

CONTRACT NO. DAA09-95-D-0001 PROJECT NR NO. SmB 464270 1 1 47980 REQUISITIONER

WA NO.	PO/CFMRR NO.	ITEM No.	REC No.	VENDOR NAME / VENDOR CODE	BUYER No.
96721	464270	1	1		

RESPONSIBILITY ☐ VENDOR ☒ TBE

NO. RECEIVED	NO. INSP	NO. REJECTED
18	18	2

PART NO	PART DESCRIPTION	SERIAL NO.	ROUTE SHEET NO.	DRAWING NO.	REV./ECOs
15-12-445-2	TUBE (51")	~~26&27~~ 28	47980	15-12-45-2	BL

DEFECT CODE(S): WB99LACK OF FUSION & POROSITY

NONCONFORMANCE: TUBES (QTY ~~1~~ 2) HAVE LACK OF FUSION

S/N 26 + 28

REFERENCE NO.(S) 464270 ☐ CONT'D ON BACK

DISPOSITION CODE(S): D08 REWORK

DISPOSITION ACTION:
HOLD TUBES IN NR CRIB POSIBLE REWORK OR OTHER DISPOSITION
REWORK PER INSTRUCTIONS ON R/S 47874(S/N 28) + 47875(SN26)

COST DATA REQ'D NO

1) MFG Labor Shop Time:		4) Ship/Rec. Time:	
2) ENGINEERING MFG:		5) Pur. Time:	
QE:		6) Acct. Time:	
DESIGN:		7) Scrap Mat'l $$ Cost of ea. unit:	
3) QA/QC Open RINR:		Tot.# of units:	
Close RINR:		8) Other Mat'l $$:	
INSP:			
Vendor QA:		☐ CONT'D ON BACK	

INITIATOR Charlie Rose Date 6/20/96

PRELIMINARY DISPOSITION: ☒ Rework ☐ Repair ☐ Use As Is ☐ Scrap ☐ RTV ☐ Void ☐ Other

DISPOSITION APPROVAL: ☒ Rework ☐ Repair ☐ Use As Is ☐ Scrap ☐ RTV ☐ Void ☐ Other ☐ Minor ☐ Major

MRB NO. ______ ☐ Deviation
MRB VALUE ______ ☐ Waiver
REPITITIVE ☐ No ☐ Yes No. ______

Recommended By Production Engineer Date
Approved By Quality Engineer Date 6/20/96
Approved By Engineering Date 7/31/96
Approved By Date
Approved By Date
Approved By Customer Date
Approved By DCMC Date

ISSUE DEBIT MEMO ☐ Yes ☐ No Explain in Disposition Action
RMA No.
Approved by Buyer Date

CAUSE CODE(S): C30 SET ERROR

RECURRENCE CONTROL (PREVENTATIVE) ACTION: REQUIRED Yes ☐ No ☒ QA CR Date 6/20/96

FAILURE ANALYSIS REQUIRED: Yes ☐ No ☒ RE ______ Date ______

ROOT CAUSE SET UP ERROR

PREVENTATIVE ACTION RECEIVED ADJUSTED SET UP OF TUBE

☐ CONT'D ON BACK

INTERIM RELEASE TO WORK

PM ______ Date ______ QA ______ Date ______ DCMC ______ Date ______

Packing List No Ship Via

Action By Shipping Dep Date

Action Completed ☒ NO Cost Data required if block is checked

Inspector Date 8/1/96

Copy Distribution ☐ ACCOUNTING ☐ QA ☐ PURCHASING ☐ CUSTOMER ☐ QC DCC ☐ VENDOR QA ☐ QE ☐ PRODUCTION ENGINEERING ☐ PRODUCTION CONTROL ☐ OTHER ☐ QC SUPERVISOR

1/21/95 4:39:10 PM

#1 REWORK
SRC SERIAL NO. EE0028TB
X-RAY FOLLOWING REWORK

TELEDYNE BROWN ENGINEERING

SOURCE INSPECTION REPORT

VENDOR: TMC CITY/STATE: HUNTSVILLE, AL

P.O. NO: 465175 ITEM NO: 1+2 P.O. CH. NO: — P/N: 12-15-445-1 + 12-15-445-2

TYPE WORK INSPECTED: WELD X-RAY PART NAME: TUBE

DWG NO: ~~12-15~~-445-1 ~~12-15~~-445-2 REV: — EO's: — S/N: -1 = 5, 26, 29, 49, 53, 56 -2 = 16, 21, 26, 28, 41, 42

P/L NO: ~~12-15~~-445-1 ~~12-15~~-445-1 15-12- REV: — EO's: — Date: 8/17/96

TYPE INSPECTION: ACCEPTANCE ☐ INPROCESS ☑ SAMPLE ☐ 100% ☐

TOTAL QTY: 12 QTY ACCEPTED: 11 QTY REJECTED: 1

DESCRIBE INSPECTION PERFORMED: (1. Give work status 2. Characteristics checked 3. How checked 4. Findings 5. Actions to be taken by vendor 6. Other pertinent information)

1) COMPLETE

2) X-RAY FILM

3) VISUAL (REF TMC REPORT 16574)

4) -1, ALL S/N'S ACC

-2, S/N'S 21, 26, 28, 41, 42 ACC

-2, S/N 16 REJ, REF NR 1537

5) SHIP TO TBE

6) NA

INSPECTOR: [signature] 8/17/96
SIGNATURE DATE

FORM 5-125D

Radiography Report Continuation

Technical Micronics Control, Inc.
210 Wynn Drive, NW/PO Box 1330
Huntsville, Alabama 35807
205-837-4430

Report No.: 16574
Page 2 of 2

Customer: Teledyne Brown Engr.	Purchase Order No.: 465175	TMC Job No.: 16574

Film Identification	Original Weld Accept	Original Weld Reject	Repair 1 Accept	Repair 1 Reject	Repair 2 Accept	Repair 2 Reject
P/N ~~17-15~~ 15-12 10/10/96 -445-1						
S/N 056 R1						
B-C			X			
P/N ~~17-15~~ 15-12 10/10/96 -445-2						
S/N 016 R1						
A-B			X-2			
B-C				X-2	TMC 10	
S/N 021 R1						
A-B			X			
S/N 026 R1						
B-C			X			
S/N 028 R1						
B-C			X-2			
C-D			X			
D-E			X-2			
S/N 041						
A-B	X-2					
B-C	X					
C-D	X-2					
D-E	X-2					
S/N 042						
A-B	X					
B-C	X-2					
C-D	X					
D-E	X-2					

Reader's Code:
1. Slag
2. Porosity
3. Lack of Pent.
4. Inc Fusion
5. Crack
6. Inclusion
7. Undercut
8. Film Artifact
9. Other

Remarks:

John Swieder — Radiographer or Reader
II — Level
8-15-96 — Date